

CENTRAL UNIVERSITY OF SOUTH BIHAR

Course Curriculum



**Doctor of Philosophy in Bioinformatics
(Ph.D. Bioinformatics) Programme**
(Effective from the Academic Session 2022-2023)

**Department of Bioinformatics
School of Earth, Biological and Environmental Sciences**

Department of Bioinformatics
School of Earth, Biological and Environmental Sciences
Central University of South Bihar
Syllabus of Ph.D. Bioinformatics
Session-2022-2023 onwards

Objectives of the Program:

- To prepare outstanding & skilled computational scientist and professionals, who could effectively translate their skills in bio, pharma and healthcare sectors, and serve in academia to provide quality training and research.

Program Outcomes:

At the end of training, students should:

- have a comprehensive understanding of scientific methods and techniques, and their application in Bioinformatics and computational sciences;
- be able to demonstrate originality in their approach in dealing with scientific problems in computational areas;
- be skilled in knowledge creation, management and application, and in the planning and implementation of research
- should be able to critically examine research findings and methodologies
- have gained oral presentation and scientific writing skills.

Eligibility:

- Master's Degree from any recognized University in Biological Sciences/Agricultural Science/Pharmaceutical Science/Veterinary Science/Medical Science/Physical Science/Chemical Science/Computer Science/IT with 55% in aggregate or its equivalent Grade B in UGC 7 point scale. A Relaxation of 5% of marks from 55 to 50% or equivalent relaxation of Grade for SC/ST/OBC (Non creamy layer)/Differently abled candidates.

Course Structure for Ph.D. (Bioinformatics)

There will be 12 credit courses for a Ph.D. student to be covered in maximum two semesters i.e. within one year of enrollment.

Semester – I/II					
Course Code	Course Title	Credits			
		L	T	P	
BIS 10 1 DC 001 02	Research Methodology	2	0	0	2
BIS 10 1 DC 002 02	Research and Publication Ethics	2	0	0	2
BIS 10 1 DC 003 04	Tools and Techniques of Research in Bioinformatics	4	0	0	4
BIS 10 1 DC 004 04	Preparation and Presentation of Research Proposal	0	0	4	4
	Total Credits				12

BIS 10 1 DC 001 02 - RESEARCH METHODOLOGY

Course Code	BIS 10 1 DC 001 02	Credits	2
L + T + P	2 + 0 + 0	Course Duration	One Semester
Semester	I/II	Contact Hours	30 Hours
Course Type	Core		
Nature of the Course	Theory		
Methods of Content Interaction	<i>Lecture, primary data collection & analysis, Hands-on Exercise</i>		
Assessment and Evaluation	<ul style="list-style-type: none">● 100% - End Term External Examination (University Examination)		

❖ **Course Objectives:**

- ❖ This course is designed to provide an overview on fundamentals of doing research including scientific terminology, literature, methods, analysis and interpretation of data, preparation of research report and presentation, future aspects of research as a career, importance and applications of scientific research to the society. It will help the students to develop core research skills relevant to a wide spectrum of biological research particularly in bioinformatics, including written and oral communication, skills in making scientific observations, and recording and analyzing data. This course further consists of teachings like Intellectual property rights, patents drafting, good laboratory procedure and practices and legal and institutional framework for biosafety.

❖ **Course Learning Outcomes:**

After completion of the course the students will be able to:

- Develop understanding of scientific methods and techniques
- Critically evaluate scientific finding and methodology adopted in literature
- Identify knowledge gap areas
- Develop skills in IPR
- Develop skills in data analysis using statistical tools

❖ **Course Contents:**

UNIT I: Research: A Conceptual Frame work

(50 % Weightage)

- Research: meaning and concept
- Knowledge, facts, principles, theories and research as source of knowledge
- Scientific method of inquiry and basic steps of research
- Types of research: Basic Applied and Action Research
- Methods and Methodology
- Intellectual Property Rights: Patents, Copyrights, GI and Trademarks, Product and process patent, Patent Treaties and Convention, process of filing patent, database of patent, search and retrieval.
- Biosafety levels, Regulations, guidelines & committees, Good Laboratory Practices (GLP)

UNIT II: Computer Applications

(50 % Weightage)

Biostatistics and Data analysis

- Rules and Principles of Scientific Method, Hypothesis and Testing a Hypothesis, Data Collection and Analysis/Sampling Theory, Interpretation of Results and Generalization
- Descriptive Statistics, Random Variable, Distribution of Random Variables, Binomial and Normal Distribution, Non Parametric Tests, Correlation and Regression

Suggested Readings:

- Khanal AB, Mahajan BS (2015) Mahajan's Methods in Biostatistics For Medical Students and Research, Jaypee Brothers Medical Publishers. New Delhi.
- Kothari CR (2019) Research Methodology: Methods and Techniques. New Age International, New Delhi
- Corley R B (2005). A Guide to Methods in The Biomedical Sciences. Springer Germany.
- Matthews RW, Bowen JM, Matthews JR (1996). Successful Scientific Writing: Guide for biological and medical science writing. Cambridge University Press UK.
- Bird, A (1998). Philosophy of Science. Routledge/Talyor & Francis, London
- Sateesh M K (2013) Bioethics And Biosafety. I K International, New Delhi.

Additional/Advance/Further Readings:

- National Academies of Sciences, Engineering, and Medicine (2019) Understanding Reproducibility and Replicability. National Academies Press, USA
- Gupta K, Karihaloo, JL, Khetarpal RK (2008) Biosafety regulations of Asia-Pacific countries. In: Biosafety regulations of Asia-Pacific countries. National Bureau of Plant Genetic Resources, New Delhi, India, ISBN 978-92-5-105828-9
- Richard WS (2000) Intellectual Property: Patents, Trademarks, and Copyrights, 2nd Edition. Delmar Cengage Learning.

BIS 10 1 DC 002 02 - RESEARCH & PUBLICATION ETHICS

Course Code	BIS 10 1 DC 002 02	Credits	2
L + T + P	2 + 0 + 0	Course Duration	One Semester
Semester	I/II	Contact Hours	30 Hours
Course Type	Core		
Nature of the Course	Theory		
Methods of Content Interaction	<i>Lecture, primary data collection & analysis, Hands-on Exercise</i>		
Assessment and Evaluation	<ul style="list-style-type: none">● 100% - End Term External Examination (University Examination)		

❖ **Course Objectives:**

- ❖ This course is designed to provide an overview on ethics, misconduct in scientific research particularly focusing on scientific research and publications. Course also aim to introduce various aspects of scientometrics

❖ **Course Learning Outcomes:**

After completion of the course the students will be able to:

- Develop skills in scientometrics
- Develop comprehensive understanding on ethical principles and scientific misconduct in scientific research and communication

❖ **Course Contents:**

UNIT I: Research and Publication Ethics: THEORY

(50 % Weightage)

- **RPE01: Philosophy and Ethics:**
 - Introduction to Philosophy: definition, nature and scope, concept, branches
 - Ethics: Definition, moral philosophy, nature of moral judgments and reactions.
- **RPE02: Scientific Conduct**
 - Ethics with respect to science and research
 - Intellectual honesty and research integrity

- Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)
- Redundant publications: duplicate and overlapping publications, salami slicing
- Selective reporting and misrepresentation of data
- **RPE03: Publication Ethics**
- Publication ethics: definition, introduction and importance
- Best practices/standards setting initiatives and guidelines: COPE, WAME etc.
- Conflicts of interest
- Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types
- Violation of publication ethics, authorship and contributorship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

UNIT II: Research and Publication Ethics: PRACTICE

(50 % Weightage)

- **RPE04: 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: UGC-CARE list of journals
- Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.
- **RPE05: Publication Misconduct**
 - A. Group discussions**
 - Subject specific ethical issues, FFP, authorship
 - Conflicts of interest
 - Complaints and appeals: examples and fraud from India and abroad
 - B. Software tools**
 - Use of plagiarism software like Turnitin, Urkund and other software tools (reference management software like EndNote, Mendeley, Zotero etc.)
- **RPE 06: Databases and research metrics**
 - A. Databases**
 - Indexing databases
 - Citation databases: Web of Science, Scopus etc.
 - B. Research Metrics**
 - Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
 - Metrics: h-index, g-index, i-10 index, altmetrics

Suggested Readings:

- MacIntyre A (1967) A Short History of Ethics. London

- Chaddah P (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.
- Resnik DB (2011) What is ethics in research & why is it important. National institute of Environmental Health Science, 1-10
<https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall J (2012) Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1-7.
http://www.insaindia.res.in/pdf/Ethics_Book.pdf

Additional/Advance/Further Readings:

- Muralidhar K, Ghosh A, Singhvi AK (2019). Ethics in Science Education, Research and Governance. Indian National Science Academy, New Delhi
- Mingers J, Leydesdroff L (2015). A Review of Theory and Practice in Scientometrics. ArXiv. <https://arxiv.org/vc/arxiv/papers/1501/1501.05462v2.pdf>

BIS 10 1 DC 003 04 - TOOLS AND TECHNIQUES OF RESEARCH IN BIOINFORMATICS

Course Code	BIS 10 1 DC 003 04	Credits	4
L + T + P	4 + 0 + 0	Course Duration	One Semester
Semester	I/II	Contact Hours	60 Hours
Course Type	Core		
Nature of the Course	Theory		
Methods of Content Interaction	<i>Lecture, primary data collection & analysis, Hands-on exercise</i>		
Assessment and Evaluation	<ul style="list-style-type: none">● 100% - End Term External Examination (University Examination)		

❖ **Course Objectives:**

- ❖ This course is designed to teach basic concept, principle and application of various instruments/tools/techniques commonly used to carry out research in bioinformatics. This course includes familiarization with general techniques, methods of data analysis and interpretation.

❖ **Course Learning Outcomes:**

After completion of the course the students will be able to:

- ❖ Learn various software tools and techniques in Bioinformatics to carry out research
- ❖ Understand statistical tools, learn how to derive meaningful answers from the available data

❖ **Course Contents:**

UNIT I: General Tools & Techniques in Bioinformatics -I (25% Weightage)

- Introduction to bioinformatics methods, sequence, structure, pattern and pathway databases and tools
- Modelling methods used in drug discovery – ligand based and structure-based design, biologics design, molecular fingerprints, virtual screening methods and scientific workflows: Pipeline Pilot and KNIME.

- Macromolecular structure prediction methods
- NGS data analysis, Microarray methods
- Brief introductions to various OMICS technologies

UNIT II: General Tools & Techniques in Bioinformatics -II (25% Weightage)

- Molecular mechanics, semi empirical and ab initio methods, advanced simulation techniques- Free-energy perturbation, metadynamics, conformation ensemble approach
- An overview of Programming Languages used in Biological Data Analysis, Database design
- Data mining techniques- clustering methods, brief introduction on various machine learning algorithms, deep learning method and Tensorflow library, AI in computational biology, Big data in biology

UNIT III: Domain Specific Tools & Techniques (50% Weightage)

- Depending on the research topics of the student, Supervisor/RAC shall advise student to pick any of the two topics from the following courses. Each of the following course carry 1-credit (10-15 Hours) of theory classes.

- Linux and Bioinformatics (25% Weightage)
- Biochemistry and Molecular Biology (25% Weightage)
- Mathematics & Statistics with R (25% Weightage)
- Programming with Perl (25% Weightage)
- Algorithm in Bioinformatics (25% Weightage)
- Bimolecular Modelling and simulations (25% Weightage)
- Transcriptomics (25% Weightage)
- Programming with Python (25% Weightage)
- Evolution and Molecular Phylogeny (25% Weightage)
- Chemoinformatics and Drug Design (25% Weightage)
- DBMS and WEB Technology (25% Weightage)
- Systems Biology (25% Weightage)
- Exome Sequencing (25% Weightage)

Suggested Readings:

- Mount DW (2004) Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press USA
- Sharma V, Munjal A, Shanker A (2016) A Text Book of Bioinformatics. Rastogi Publications, Meerut
- Claverie JM, Notredame C (2003) Bioinformatics A Beginners Guide, Wiley Dreamtech India, New Delhi
- Baxevaniv AD, Francis Ouellette BF (2009) Bioinformatics Wiley
- Jensen F (2006) Introduction to Computational Chemistry, Wiley–Blackwell
- Géron A (2019) Hands-On Machine Learning with Scikit-Learn and TensorFlow. O'Reilly Media USA
- Goodfellow I, Bengio Y, Courville A (2016) Deep Learning, The MIT Press Boston

Additional/Advance/Further Readings:

- Rami Reddy M, Erion MD (2001) Free Energy Calculations in Rational Drug Design, Springer

BIS 10 1 DC 004 04 – PREPARATION AND PRESENTATION OF RESEARCH PROPOSAL

Course Code	BIS 10 1 DC 004 04	Credits	4
L + T + P	0 + 0 + 4	Course Duration	One Semester
Semester	I/II	Contact Hours	120 Hours
Course Type	Core		
Nature of the Course	Theory, Review of Literature, Preliminary Experiments		
Methods of Content Interaction	<i>(Primary data collection & Identifying the Gap Area of Research Literature Review, Synopsis Presentation)</i>		
Assessment and Evaluation	<ul style="list-style-type: none"> ● 100% - End Term External Examination (University Examination) ● Submission of Research Proposal and Presentation to Research Advisory Committee (PhD student specific) and Department Research Degree Committee (DRDC). The student is required to present periodically before Research Advisory Committee consisting of 2 external faculties along with the guide. 		

❖ **Course Objectives:**

- ❖ This course is designed to prepare the students for the research topic that he/she will take for Ph.D. degree. This course consists of review of literature, presentation and finalizing the proposed area of research. In this course, students are required to identify knowledge gap areas through a thorough review of literature and formulate research problems.

❖ **Course Learning Outcomes:**

After completion of the course the students will be able to:

- ❖ Review scholarly literature & critically assess the emerging trends and technology in the field
- ❖ Formulate Scientific problems and identify knowledge gap areas
- ❖ Learn methodical scientific enquiry in a given field

❖ **Course Contents:**

- Self-study and investigations, Periodical interactions with guide, faculties and RAC members