

MAHATMA GANDHI UNIVERSITY, NALGONDA

DEPARTMENT OF BIOTECHNOLOGY

PRE-PHD SYLLABUS

PAPER I – RESEARCH METHODOLOGY (BIOTECHNOLOGY)

UNIT I: TOOLS AND TECHNIQUES IN RESEARCH AND STATISTICS

- 1.1. Centrifugation techniques- Principle, types & applications
- 1.2. Spectrophotometric techniques- Principle, types & applications
- 1.3. Chromatographic techniques-Principle, types & applications
- 1.4. Electrophoretic techniques- Principle, types & applications
- 1.5. Microscopy- Principle, types & applications
- 1.6. Types of PCR and applications, Real time PCR
- 1.7. Introduction to Biostatistics, Sample size - measures of dispersion, measures of central tendency. Tests of significance- Z-test, paired & unpaired t-test, F-test, Chi-square test and ANOVA

UNIT II: RECOMBINANT DNA TECHNOLOGY

- 2.1. Restriction enzymes and types; Modifying enzymes- Methylases, Polymerases, Ligases, Kinases, Phosphatases, Nucleases
- 2.2. Vectors for cloning, expression (gateway cloning vectors) and library preparation (Lambda phage vectors, Cosmids, BAC, YAC), prokaryotic (*E. coli*) and eukaryotic (Yeast) hosts
- 2.3. Strategies for construction of genome sequencing and Transcriptome
- 2.4. Selection of recombinant clones - Insertional Inactivation, Alpha-Complementation, PCR screening, immunological screening for expressed genes.
- 2.5. Advanced techniques in r-DNA technology- site directed mutagenesis, RNA interference, Knock-in and knock-out technology, Genome editing technologies- CRISPR-CAS system, TALENs & Zinc finger Nucleases. Genome silencing. Synthetic Biology.

UNIT III: BIOINFORMATICS

- 3.1. Introduction to Bioinformatics
- 3.2. Bioinformatics Resources: Sequence databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: UniProt (SCOP, CATH): Swiss-Prot, ClustalMap; RAP-db databases, Plant genome data bases
- 3.3. Sequence alignment: Basic concepts of sequence alignment, Dot plots, Pairwise sequence alignment, Multiple sequence alignment, BLAST and FASTA algorithms and phylogenetic analysis methods (NJ and ML)
- 3.4. Genomics: Gene annotation in prokaryotes and eukaryotes using Bioinformatics tools, Proteomics- Protein structure prediction and Molecular docking.

UNIT IV: RESEARCH CONCEPTS

- 4.1. Introduction to research concepts
 - a) Philosophy & Meaning of Research, Basic research, applied research and need based research; Identification and defining of the problem

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- b) Literature survey: the search for facts; the verification of facts; the analysis of evidence; truth & causation; Sources of prejudice and bias
- c) Library reference schemes; Note making, Lab record, Internet.
- 4.2. Research proposal design & formulation; Hypothesis- Direct & alternate methods; Research methodology; Data collection & validation
- 4.3. Statistical approach, Validation of findings, Plagiarism, Research communications and Impact factor of journals
- 4.4. The structure of a thesis; Language, style & format in the thesis, References & styles

Reference books

1. Biophysical Chemistry by Upadhyay, Upadhyay and Nath 4th edition, Himalaya publishing House, Mumbai.
2. Practical Biochemistry by Keith Wilson and John Walker, 5th edition, Cambridge University press, U.K.
3. Molecular Biology of the gene by J. Watson
4. Genes Vol VI, VII and VIII by Benjamin Lewi
5. Molecular Biotechnology Principles and application of recombinant DNA
6. Principles of Gene manipulation by R.W. Old and S.B. Primrose
7. Recombinant DNA: A short course by J. Watson, Tooze and Kurtz
8. Bioinformatics: Sequence and Genome Analysis by David W. Mount, ColdSpringHarbor Laboratory Press
9. Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press.
10. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition by Andreas D. Baxeavanis, B. F. Francis Ouellette, Wiley-Interscience.
11. Introduction to Biostatistics by Robert Sokal and James Rohlf, Dover publications

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PAPER II – BASICS OF BIOTECHNOLOGY

MODULE-I: MOLECULAR BIOLOGY & rDNA TECHNOLOGY

- DNA structure and chemical composition, DNA Replication, Repair
- Mechanism of Transcription & Translation
- Regulation of prokaryotic gene expression -lac operon
- Isolation of genes, Competent Cell preparation, Transformation
- Cloning vectors: Properties of a good vector, Plasmid vectors- PBR322, PUC18
- Hybridization techniques: Western, Southern and Northern hybridization. Probe preparation

MODULE-II: MICROBIAL BIOTECHNOLOGY

- Isolation, screening, and selection of microorganisms for industrial purposes
- Production of Microbial Products - Antibiotics (streptomycin), Acetone, Microbial Enzymes (L-Lysine) and Organic Acids (Citric acid).
- Bioenergy – Biomass as source of energy
Biofertilizers, Biopesticides & Bioremediation

MODULE III: PLANT BIOTECHNOLOGY

- Media composition for plant tissue culture- MS media
- Callus and Suspension cultures.
- Micropropagation, Somatic Hybridization.
- Methods of direct gene transfer in plants-Particle gun bombardment, electroporation, Agrobacterium mediated Transformation

MODULE-IV: ANIMAL & MEDICAL BIOTECHNOLOGY

- Cell culture: Primary cell culture & establishment of cell lines.
- Hybridoma Technology, Stem cell Technology.
- Principle and applications of Gene knock out technique
- Molecular markers- RFLP, RAPD, STRs, SNP's, and their applications
- Immuno-techniques: RIA, ELISA, Immunofluorescence
- DNA Fingerprinting

Reference books

- Genes Vol VI, VII and VIII by Benjamin Lewi
- Molecular Biotechnology Principles and application of recombinant DNA
- Principles of Gene manipulation by R. W. Old and S.B. Primrose
- Recombinant DNA: A short course by J. Watson, Tooze and Kurtz

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MAHATMA GANDHI UNIVERSITY, NALGONDA
PAPER-III: RESEARCH AND PUBLICATION ETHICS
(COMMON TO ALL FACULTIES)

2 Credits; 2 PPW

UNIT - I

A. PHILOSOPHY AND ETHICS: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgments and reactions.

B. SCIENTIFIC CONDUCT: Ethics with respect to research in science disciplines and research in social sciences, 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.

C. PUBLICATIN ETHICS: Publication Ethics : Definition, 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. references. Bibliography.

UNIT - II

A. OPEN ACCESS PUBLISHING: Open access publications and initiatives, SHERPA/Romeo online resource to check publisher copyright & self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester etc..

B. PUBLICATION MISCONDUCT: Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: Examples and fraud from India and abroad.

Use of plagiarism softwares like Turnitin, Urkund and other open source software tools.

C. DATABASES AND RESEARCH METRICS: Indexing databases, Citation databases: Web of Science, Scopus etc., ISSN Vs ISBN, Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g-index, i-10 index, almetrics.

References:

- Bird, A (2006), *Philosophy of Science*, Routledge
MacIntyre, Alasdair (1967) *A Short History of Ethics*, London
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.
Resnik, D. (2020, December 23). *What is ethics in research & why is it important?* National Institute of Environmental Health Sciences, Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
BeCALL, J. (2012), *Predatory publishers are corrupting open access*. Nature, 489 (7415), 179-179. <https://doi.org/10.1038/489179a>
Indian National Science Academy IINSA), *Ethics in Science Education, Research and Governance* (2019), ISBN: 978-81-939482-1-7.
https://www.insaindia.res.in/pdf/Ethics_Book.pdf

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