CENTRAL UNIVERSITY OF KARNATAKA
(Established by an Act of the Parliament in 2009)

CENTRAL UNIVERSITY OF KARNATAKA

School of Life Science
Kadaganchi, Aland Road
Kalaburagi - 585 367

Department of Life sciences
Ph. D. Course work

Overview: The coursework consists of four sections that focus on fundamental principles in research methods and include a variety of choice-based modules such as molecular biology-based techniques, microscopy, and immunological techniques, protein purification, plantand animal cell culture techniques, and recent advances in genomics and proteomics, among other things. Fundamental Biosafety related topics are also covered. And further statistical analysis is crucial in biology, biostatistics and bioinformatics, and data analyses. Besides, research and scientific communication, publishing ethics, and research integrity are also enclosed.

S. No.	No. of sections	Name of the Course		Code	No. of credits
1.	**Section –I**	**Research Methodology**		**RM**	**04**
	Compulsory	Module 1	Basic Molecular Biology Techniques		
	Any three modules from (2-6)	Module 2	Microscopy and Immunological Techniques		
		Module 3	Protein Dynamics and Proteomics		
		Module 4	Plant tissue Culture Techniques		
		Module 5	Advances in genomics and Bio-informatics tools		
		Module 6	Animal Tissue Culture Techniques		
2.	**Section –II**	**Biosafety, Biostatistics & Data analysis**		**BBD**	**04**
3.	**Section –III**	**Research & Scientific Communication**		**RSC**	**02**
4.	**Section –IV**	**Scientific & Publication Ethics**		**SPE**	**02**
Total credits					**12**

Research methodology is compulsory module, and students must select any three of the modules from the remaining five. Total of 100 marks (Internal- 40 marks and final exam- 60 marks). Passing marks are 55%.

Note: According to the UGC rules Part III-Sec 4 (7.5) that the University has adopted, all Ph.D. students must finish course work with a grade of 55 percent or higher before two semesters, otherwise their registration would be terminated.

SECTION –I
(Research Methodology)

Module 1: Basic Molecular Biology Techniques (Compulsory):

A). DNA, RNA, and Protein extraction and quantification. Amplification of known DNA sequences by Polymerase Chain Reaction (PCR). qRT- PCR. Use of different variant of PCR. Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis, SDS polyacrylamide gel electrophoresis.Blotting techniques (Western, Southern and northern). Gene silencing by siRNA/shRNA.

B). Biological data bases (Protein and DNA). NCBI, Gene bank, FASTA, and Primer designing. Identification of promoter sequence. Micro RNA and its targets. Retrieving and analyzing public databases on genomes/proteins.

Module 2: Microscopy and Immunological Techniques:

C). Microscope history; Simple & Compound Microscopes; Light & Dark Field; Phase contract & DIC; Fluorescence & Confocal; SEM & TEM microscopes and their applications.

D). Immunology (Antigen-antibody interaction; Precipitation and agglutination reactions); Immunoblots, ELISA, Flow cytometry analysis and sorting (demo), Raising of antibodies against a protein/peptide in rabbit/mouse/rat. ICC, IHC

Module 3: Protein Dynamics and Proteomics:

E). X-ray crystallography, Protein crystallization and methods for determination of protein structure. Spectroscopic techniques including UV-Visible, IR, fluorescence Spectrophotometer, SPR, FT and NMR.

F). Protein dynamics and modeling. Protein mass determination and characterization of proteins by use of Mass spectrometry (MALDI-TOF, LC-MS).

Module 4: Plant Tissue Culture Techniques:

G). Basic techniques & methodology in plant tissue culture; Explants selection, sterilization, inoculation, and various media preparations. Callus induction and clonal propagation. Initiation and maintenance of callus cultures, and cell suspensions. Role of plant growth regulators in plant differentiation and morphogenesis. Somatic embryogenesis, organogenesis and factors affecting them.

H). Molecular overview of somatic embryogenesis: meristem, anther, zygotic embryo, and endosperm culture - importance and applications. Protoplast culture, isolation, purification and methods used for protoplast fusion. Synthetic seed production and their applications.

Micropropagation: uses and commercial exploitation. Production of haploids using anther, their characterization and application.

Module 5: Advances in genomics and Bio-informatics tools:

I). GMOs: Introduction, history, policy around the world. Use of G'Mos and their release in the environment. Molecular Markers. QTLs and QTL seq approach. Single Nucleotide Polymorphisms. Sequencing methods, Enzymatic DNA sequencing, Chemical sequencing of DNA, Automated DNA Sequencing, Chemical Synthesis of oligonucleotides, GBS (Genotyping By Sequencing), Next Generation Sequencing. GWAS (genome-wide association study).

J). Transcriptomics, Micro-array, RNA-seq, RNA-seq based trait mapping. Gene silencing, PTGS, RNai, Antisense technology, Applications. Gene and genome editing, Genome editing tools- ZFNs, TALENs and CRISPR-Cas9. Basics of sequence alignment. Phylogenetic analysis. Multiple sequence alignment. Studying the correlation of gene expression with relevant diseases exp; cancer, arthritis etc.

Module 6: Animal Tissue Culture Techniques:

K). Source and isolation of stem cells. Embryonic and adult stem cells. Potency of cells;. Basic techniques of animal cell and tissue culture and its application. Primary cells, cell lines, cell immortalization, Sub-culturing and cell viability assays

L). Basic contaminants of animal cell cultures and their detection. Gene transfer in animal systems; Gene therapy. Animal virus derived vectors -SV40 and retroviral vectors. Transgenic animals; Animal cloning and in-vitro fertilization; animal models; Animal Handling

References:

1. Hames, B. D. (Ed.). (1998). *Gel electrophoresis of proteins: a practical approach* (Vol. 197). OUP Oxford.
2. Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology*. Cambridge university press.
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4. Sadasivam, S. (1996). *Biochemical methods*. New Age International.
5. Owen, J. A., Punt, J., & Stranford, S. A. (2013). *Kuby immunology* (p. 574). New York, NY, USA: WH Freeman.
6. Janeway Jr, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). Principles of innate

and adaptive immunity. In *Immunobiology: The Immune System in Health and Disease. 5th edition*. Garland Science.
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10. Walker, J. M. (2000). *Principles and techniques of practical biochemistry*. Cambridge University Press.
11. Scopes, R. K. (1993). *Protein purification: principles and practice*. Springer Science & Business Media.
12. Boyer, R. (2000). *Modern experimental biochemistry*. Pearson Education India.
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14. Reinert, J., & Bajaj, Y. S. (Eds.). (2013). *Applied and fundamental aspects of plant cell, tissue, and organ culture*. Springer Science & Business Media.
15. Chawla, H. (2011). *Introduction to plant biotechnology*. CRC Press.
16. Mantell, S. H., Matthews, J. A., & McKee, R. A. (1985). *Principles of plant biotechnology: an introduction to genetic engineering in plants* (No. BOOK). Blackwell Scientific Publications.
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22. Freshney, R. I. (2015). *Culture of animal cells: a manual of basic technique and specialized applications*. John Wiley & Sons.
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24. Brignier, A. C., & Gewirtz, A. M. (2010). Embryonic and adult stem cell therapy. *Journal of Allergy and Clinical Immunology*, *125*(2), S336-S344.
25. Migishima, F., Oikawa, A., Kondo, S., Ema, H., Morita, Y., Nakauchi, H., & Shinohara, N. (2003). Full reconstitution of hematopoietic system by murine umbilical cord blood. *Transplantation*, *75*(11), 1820-1826.

SECTION –II
(Biosafety, Biostatistics & Data analysis)

I). Biosafety and Ethics:

A). Guidelines of Biosafety; Institutional Biosafety committee; Laboratory behavior; Good Laboratory Practices; Responsibilities of a researcher; Handling and storage of biological material and disposal of hazardous materials (chemical & biological) ; Laboratory waste disposal; Maintenance of personnel and PI facilities including equipments; Maintenance of laboratory notebooks

B). Research using animals if any (Institutional Animal ethics committee (IAEC)); Research with Human Subjects if any (Institutional ethics committee (IEC)); Research with Stem Cells if any (Institutional committee for stem cell research (IC-SCR))

II). Biostatistics and Data analysis:

C). Concepts of confidence intervals & comparing groups. Confidence interval of a proportion. The standard deviation (mean, median, mode). Confidence Interval of a Difference between Means, ratio of two proportions, Case-Control using standard Statistical tests. Introduction to p-values. Statistical significance and hypothesis testing. Interpreting significant and not significant P values. Multiple comparisons. Correlation and regression analysis. Analysis of Variance (ANOVA): analysis of variance for one-way classified data, analysis of variance for two-way classified data with one observation for cell.

D). Data science; predictive modeling, Pearson's and Spearman's Rank correlation; R program

References:

1. Casella, G., & Berger, R. L. (2021). *Statistical inference*. Cengage Learning.
2. Davies, O. L. (1947). Statistical methods in research and production. *Statistical methods in research and production.*
3. Ewens, W. J., & Grant, G. R. (2005). *Statistical methods in bioinformatics: an introduction* (Vol. 15). New York: Springer.
4. Waterman, M. S. (2018). *Introduction to computational biology: maps, sequences and genomes*. Chapman and Hall/CRC.
5. Pathak, R. K., Singh, D. B., & Singh, R. (2022). Introduction to basics of bioinformatics. In *Bioinformatics* (pp. 1-15). Academic Press.
6. Barnes, M. R., & Gray, I. C. (Eds.). (2003). *Bioinformatics for geneticists*. John Wiley & Sons.

SECTION –III
(Research & Scientific Communication)

I). Research Proposal:

A). Student should write a research proposal based on his/her work in a prescribed format given by supervisor. Pre-submission of abstract with significance of the work and objectives to be achieved in 300- 500 words.

B). Structure of Research proposal (including title; Origin of the proposal (Background); Art of state (Abstract); Key words; Major Objectives; Hypothesis building; Rationale of the paper; Methodology (Work plan); Overview of status of Research and Development in the subject; (Review of Literature- National and international status; Importance of the proposed project in the context of current status & beyond the scope of project; Project summary; & Bibliography).

II). Scientific Communication:

C). Students have to write a review article (~ 8-15 pages) of his/her choice or may consult his/her Ph.D. supervisor for selecting the topic. The full-manuscript of the review to be submitted to the Ph.D. supervisor. Thesis presentation (Title page; Table of contents; Headings and sub-headings; Presentation of tables and figures; Abbreviations; Pagination; Footnotes; Referencing; & Appendices, etc)

D). Types of manuscripts including full length research paper; short and brief communications; Review articles; Review of manuscripts; Proof Reading, & Technical resumes. Different components of a full length research paper (Title; Abstract; key words; Introduction, Aims and objectives; Hypothesis building; Materials and methodology; Results and discussion; Acknowledgement; Conflict of interest statement; & Bibliography).

References:

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3. Katz, M. J. (2009). *From research to manuscript: A guide to scientific writing*. Springer Science & Business Media.
4. Eco, U. (2015). *How to write a thesis*. MIT Press.
5. Pfleegor, A. G., Katz, M., & Bowers, M. T. (2019). Publish, perish, or salami slice? Authorship ethics in an emerging field. *Journal of Business Ethics*, *156*(1), 189-208.
6. Zobel, J., Gruba, P., & Evans, D. (2014). How to write a better Thesis.
7. Denicolo, P., & Becker, L. (2012). *Developing research proposals*. Sage.
8. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.
9. Holmes, D., Moody, P., Dine, D., & Trueman, L. (2017). *Research methods for the biosciences*. Oxford university press.

SECTION –IV
(Scientific & Publication Ethics)

I). Scientific & Publication Ethics:

A). Meaning and definitions of Research; Significance of research; Types of research; Research in India; Science and ethics; Responsibilities and qualities of scientists (truthfulness, simplicity, humility, open mindedness; attitude of service towards social and human well being).

B). Some ethical issues in science with examples from different disciplines, e.g. biotechnology, medical sciences, defense research and development, environmental issues; Authorship issues; Plagiarism; IPR: Patents; Copyright; & Trademarks.

II). Research Metrics:

C). How to cite and how to do referencing; Literature search technique using SCOPUS, Google Scholar, PUBMED, Web of Science, Indian Citation Index, and Research Gate.

D). Styles of referencing (APA, MLA, Oxford, Harvard, Chicago); bibliography softwares (Grammarly, Endnote & Mendely etc); Impact Factor; h index & i10 etc.

References:

1. Callahan, D., & Bok, S. (Eds.). (2012). *Ethics teaching in higher education*. Springer Science & Business Media.
2. Kapur, J. N. (1996). *Ethical values for excellence in education and science*. Wishwa Prakashan.
3. David, P. A. (2004). Can" open science" be protected from the evolving regime of IPR protections?. *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, 9-34.
4. Baggs, J. G. (2008). Issues and rules for authors concerning authorship versus acknowledgements, dual publication, self plagiarism, and salami publishing.
5. Buranen, L., & Roy, A. M. (Eds.). (1999). *Perspectives on plagiarism and intellectual property in a postmodern world*. SUNY Press.
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