Criterion-3: Research Innovations and Extension

Key Indicator – 3.4: Research Publications and Awards

Metric: 3.4.1

Inclusion of research ethics in the research methodology course work

Each department teaches the research ethics course as per the syllabus prescribed by the UGC. All departments follow the same content for research ethics. For research methodology, the departments make a few changes based on their subject. All syllabi are approved by the Board of Research Studies of the concerned Department.

Research methodology Course content for few departments:
Modern Indian Language and Literary Studies:
https://www.du.ac.in/du/uploads/research/course-work/MILLS.pdf

Philosophy:
https://www.du.ac.in/du/uploads/departments/Philosophy/philosophy_Course-work.pdf

Psychology:
https://psychology.du.ac.in/?Academics/PhD/Coursework-Syllabus

Punjabi:
https://www.punjabi.du.ac.in/userfiles/downloads/PhDinPunjabi/Syllabus/Syllabus%20Ph%20D%20Course%20Work%20%20(1)%20(1).pdf

Bio-chemistry:
https://biochem.du.ac.in/userfiles/downloads/Revised%20PhD%20Coursework%20Syllabus%20%20July%202023.pdf

Biophysics:
https://www.du.ac.in/du/uploads/research/course-work/11032016_Bio-physics.pdf

Electronics:
https://electronics.du.ac.in/docs/programsyllabus.pdf

Plant Molecular Biology:
https://naac.du.ac.in/ssr/pdf/1.1.2%20Syllabus%20Revision/1.1.2-PMB.pdf

Mathematics:
https://maths.du.ac.in/Courses/PhD/PDF/2021-22%20MPhil%20PhD%20course%20work%20Syllabus.pdf

Operational Research:
https://www.du.ac.in/uploads/Ph.D.%20syllabus/09052019_PhD-Syllabus_OR.pdf

Botany:
https://www.du.ac.in/du/uploads/06122017_Botany_PhD.pdf

ACBR:
https://www.du.ac.in/du/uploads/research/course-work/19052016_ACBR.pdf

Department of Finance and Business Economics

Syllabus and Scheme of Examination for

Pre-Ph.D Coursework

2022-23

Department of Finance and Business Economics
University of Delhi South Campus, New Delhi
Pre-Ph.D Course Work
2022-23

1. Ph.D. students who are required to do course work have to clear total two papers in each semester (i.e. a total of 4 papers in two semesters). Papers 1 and 2 are compulsory and students are required to choose any one of papers 3 or 4 and paper 5.

2. Students will be evaluated at the end of each semester. For each course, evaluation will be based on a written examination and a term paper/ project study.

3. Each paper will be of 100 marks with equal weightage (that is 50%) for both the components, i.e., written examination and term paper/project study.

4. 50% will be the passing marks for **each** component of each paper.

5. Students should clear all papers and score 55% in the aggregate of all 4 papers for successful completion of the Coursework.

6. Students can carry ER (Essential Repeat) in at most one paper in each semester, otherwise she/he will be declared as 'Not qualified' in the course work.

Pre-Ph.D. Coursework

2022-22

Semester- 1	**Paper Title**
Paper - 1	Research Methodology, Data Analysis and Research Ethics
Paper - 2	Essentials of Econometrics
Semester- 2	
Paper - 3	Time Series Econometrics
Paper - 4	Applied Econometrics
Paper - 5	Research Seminar Course in Finance or Business economics

Note : Papers 1 and 2 are compulsory and students are required to choose any one of papers 3 or 4 and paper 5.

Paper 1

Research Methodology, Data Analysis and Research Ethics

Syllabus

This Course especially focuses on Research Writing, Critical Review of Literature, Research and Publication Ethics, Open Access publishing, Databases and Research Metrics .

It also focuses Mathematics, Sampling Techniques and Questionnaire Design for Primary Research and basics of Data Analysis and Statistical Inference, including :

- Research philosophy—Method of knowing; Epistemology-Positivism, empiricism and realism; Post positivism: interpretivism, constructionism, and critical realism.. Ontology- objectivism, and constructionism. Epistemological and ontological considerations in research. Research approaches- inductivism and deductivism. Scientific research - Research Process. Conceptualization-Problem formulation.
- Literature review, concept mapping. Setting Research objectives and hypotheses formulation. Concepts, constructs and variables-Independent, dependent, moderating, intervening, and extraneous. Research designs: exploratory, descriptive- Cross-sectional and Longitudinal designs.
- Survey research and case-studies. Planning a survey research
- Experimental Designs: Internal and external validities in experimentation-Types of experimental designs vis-a-vis control of internal validities- after only, before-after, before-after with control and Solomon- Four designs. Completely randomized, Randomized Block, and Latin square designs. Quasi-experimental designs
- Measurement and scaling techniques. Four levels of measurement; Ranking and rating scales, Attitude measurement- Likert Scale and Semantic differential scale
- Reliability- stability and internal consistency; and validity- content, criterion related and construct validities in measurement:
- Qualitative Research: Unobtrusive measures:. Grounded Theories, Analyzing qualitative data
- Methods of data collection: Secondary sources; Interview method, ethnographic methods and participant analysis. Designing a questionnaire

- Review of Data Analysis Tools and Probability Theory (including Discrete and Continuous probability distributions)
- Sampling and Estimation: Types of Sampling, Point Estimation, Properties of Estimators (unbiasedness, efficiency, consistency, asymptotic normality), Sampling Distribution of Sample Mean and Proportion, Chi-square, t and F distributions, Convergence in Probability, Law of Large Numbers, Convergence in Distribution, Central Limit Theorem; Interval Estimation and Confidence Intervals for population parameters.

- Hypotheses Testing : Null and Alternate Hypotheses; One-tailed and two-tailed Tests; Type I and Type II errors; Power of a Test; p-values; Parametric and Non-parametric Tests.
- Analysis of Variance : One Way and Two-Way
- Applications of Differential and Integral Calculus in Business Economics and Finance; Difference and Differential Equations; Applications of Matrices and Linear Algebra in Business Economics and Finance; Optimization - Minima and Maxima – One Variable, Multiple Variables; Unconstrained and Constrained Optimization

Readings

Anderson, D.R., Sweeney, D. J. and Williams, T. A. Statistics for Business and Economics Thomson South-Western College Publishing. (Latest Edition)

Chiang, A.C., Fundamentals of Mathematical Economics. Mc Graw Hill (Latest Edition)

Wooldridge, J.M. (2012), *Introductory econometrics: A modern approach*, 5th Edition, Cengage Learning.

Malhotra, N.K. and S.Dash (2007), Marketing Research : An Applied Orientation, Latest Edn, Pearson.

Area specific Readings for Literature Review, Research Writing and Research and Publication Ethics (to be circulated in class) will include recent Articles published in scholarly journals.

Paper 2

Essentials of Econometrics

Syllabus

1. Simple Linear Regression: The 2-variable OLS Model, Assumptions, Estimation, Interpretation of Coefficients, Hypotheses Testing, Prediction and Residual Analysis.
2. Multiple Regression Analysis: Assumptions and interpretation of multiple regression equation; $R^2$and $\bar{R}^2$; Hypothesis testing : for individual and overall significance, for equality of two regression coefficients, and for linear equality restrictions; Different functional forms of regression models (e.g., Log-log, Semi-log, Quadratic and Interaction terms etc.).
3. Binary variables in linear regression, including an introduction to binary dependent variables and the linear probability model.
4. The problem of Multicollinearity: Nature, Consequences, Detection techniques and remedial measures.
5. The problem of Heteroscedasticity: Nature, Consequences, Detection techniques and remedial measures.
6. Introduction to time series regression: Autocorrelation - Nature, Consequences, Detection techniques and remedial measures.

Readings

1. Dougherty Christopher (2011),*Introduction to Econometrics*, 4th edition, Oxford University Press, Indian edition.
2. Stock, James H. and Mark W. Watson (2014), Introduction to Econometrics. 3rdEdn. Pearson Education Addison Wesley
3. Wooldridge, J.M. (2012), *Introductory econometrics: A modern approach*, 5th Edition, Cengage Learning.

Paper 3

Time Series Econometrics

Syllabus

1. Forecasting Theory and Methods: Overview and Types of Forecasts
2. Forecasting with a Single-Equation Regression Model: Unconditional Forecasting, Forecasting with Serially Correlated Errors, Conditional Forecasting
3. Smoothing and Extrapolation of Time Series: Simple Extrapolation Models, Smoothing and Seasonal Adjustment
4. Properties of Stochastic Time Series: Characterizing Time Series: the Autocorrelation Function, Stationarity, Random Walk, Testing for Random Walks, Co-integrated Time Series
5. Linear Time Series: Moving Average Models, Autoregressive Models, Mixed Autoregressive and Moving Average Models, Homogeneous Non-Stationary Processes: ARIMA Models, Box-Jenkins Methodology, Specification of ARIMA Models, SARIMA, ARMAX Models
6. Forecasting with Time Series Models: Computing a Forecast, The Forecast Error,
   Properties of ARIMA Forecasts
7. Causality, Exogeneity, VAR, Impulse Response Functions, Volatility Measurement, Modeling and Forecasting: The ARCH Process, The GARCH Process
8. Volatility Estimation in a Multivariate Framework.
9. ARDL Model

Readings

1. Box, George E.P., Gwilym M. Jenkings and Gregory C. Reinsel (2009) Time Series Analysis: Forecasting and Control 3rdEdn. Pearson Education
2. Enders, Walter (2004) Applied Econometric Time Series. Wiley
3. Evans, Michael K. (2003). *Practical Business Forecasting*. UK: Blackwell.
4. Hanke, John E. and Dean W. Wichern (2005). Business Forecasting. 8thEdn. New Delhi: Pearson-Prentice Hall
5. Makridakis, Spyros, Steven C. Wheelwright and Rob J. Hyndman (1998). *Forecasting: Methods and Applications*. 3rdEdn. USA: John Wiley and Sons
6. Pindyck, Robert S. and Daniel L. Rubinfeld. (1997). *Econometric Models and Economic Forecasts*. 3rdEdn. New York: McGraw Hill.
7. Stock, James H. and Mark W. Watson (2014). Introduction to Econometrics. 3rdEdn. Pearson Education Addison Wesley

Paper 4

Applied Econometrics

Syllabus

1. Pooled cross section and panel data models : Pooling time series and cross-section data; fixed effects; random effects; dynamic models

2. Instrumental variables and Two-stage least squares (2SLS) : Tests for endogeneity; Applying 2SLS with heteroskedasticity; Applying 2SLS to time-series equations, pooled cross-sections and panel data.

3. Simultaneous equations models (SEM) : Simultaneity bias; Estimating structural equation; Systems with more than two equations; Applying 2SLS to time-series equations and panel data.

4. Limited dependent variable models : Logit and probit models; Tobit Model; Poisson Regression Model; Truncated and censored regression models.

Readings

1. Cameron, A. and P.Trivedi (1998) : Regression analysis of count data, Cambridge , Cambridge Press University.
2. Cameron, A. and P. Trivedi (2005), Microeconometrics: Methods and Applications, Cambridge Press University.
3. Davidson, R. and J.MacKinnon (2004): Econometric theory and methods, Oxford, Oxford University Press.
4. Hsiao, C. (1986) : Analysis of panel data, Cambridge , Cambridge University Press
5. Maddala, G. (1983) : Limited-dependent and qualitative variables in econometrics Cambridge , Cambridge University Press.
6. Wooldridge, J.M. (2012), *Introductory econometrics: A modern approach*, 5th Edition, Cengage Learning.
7. Wooldridge, J.M. (2002): Econometric analysis of cross-section and panel data, Cambridge, Mass. MIT Press.

Paper 5

Research Seminar Course in Business Economics

Syllabus

This Course introduces students to advanced research areas in Business Economics. It aims to build a strong conceptual foundation in core areas of specialization in Business Economics.

Readings

Readings for this course (to be circulated in class) will include recent Articles published in scholarly journals.

OR

Research Seminar Course in Finance

Syllabus

This Course introduces students to advanced research areas in Finance. It aims to build a strong conceptual foundation in core areas of specialization in Finance.

Readings

Readings for this course (to be circulated in class) will include recent Articles published in scholarly journals.

DEPARTMENT OF GENETICS

FACULTY OF INTERDISCIPINARY & APPLIED SCIENCES

UNIVERSITY OF DELHI SOUTH CAMPUS

Syllabus for Ph.D course work (2023 onward)

The department offers the following seven papers (one compulsory and six optional papers) for the Ph. D course work.

Paper code	Course	Credits
	Compulsory Course	
PGEN001:	Research Methodology	4 credits
	Optional Courses (any two courses to be selected)	
PGEN002:	Genetic Toolkits to Study Genes, Development and Diseases	4 credits
PGEN003:	Introduction to *Dictyostelium discoideum*	4 credits
PGEN004:	Introductory Course on Cancer Research	4 credits
PGEN005:	Mitochondrial Physiology and its Consequences on Cellular Fitness: *S. cerevisiae* a model system	4 credits
PGEN006:	Plant –Microbe Interactions	4 credits
PGEN007:	Reviewing Regulation of Gene Expression	4 credits

The department will be offering the above listed courses/ papers as Ph.D course work to the Ph.D scholars. Students will have to select minimum 8 credits courses from the above list of papers (4 credit compulsory research methodology course + any one course from the list of optional papers with 4 credits), along with an UGC recommended 2 credit compulsory course on research ethics. Students are free to choose additional courses of their choice from the list of optional courses. Students will be encouraged to choose one optional course of the immediate relevance to their research work/ lab and another (if opted) courses from the allied areas. These courses are also open for the Ph.D students of other departments. The students of the department of genetics are also free to choose papers from Ph.D courses offered by other departments. A Ph.D student has to qualify all the opted papers (minimum 8 credits courses + 2 credit UGC recommended compulsory course on research ethics) as specified above in one year (two semesters) to have successfully completed the Ph.D. course work.

Evaluation: All the courses will have components of end semester examination and continuing evaluation. The total marks for a 4 credits course will be 100. A Ph.D student has to score minimum 50% marks to qualify a paper. The course-wise distribution of marks is as follows:

Paper	End semester examination	Continuing assessment	Total marks
PGEN001: Research Methodology	70	30	**100**
PGEN002: Genetic Toolkits to Study Genes, Development and Diseases	70	30	**100**
PGEN003: Introduction to *Dictyostelium discoideum*	70	30	**100**
PGEN004: Introductory Course on Cancer Research	70	30	**100**
PGEN005: Mitochondrial Physiology and its Consequences on Cellular Fitness: *S. cerevisiae* a model system	70	30	**100**
PGEN006: Plant –Microbe Interactions	70	30	**100**
PGEN007: Reviewing Regulation of Gene Expression	70	30	**100**

All seven courses will be offered in the July to December semester.

Brief preamble of each courses/ papers have been provided below:

PGEN001- Research Methodology (4 credits): This course is aimed at teaching the essentials to fresh Ph.D students to train them in the appropriate research methods that they should inculcate early on in their scientific pursuit. This course also revisit the concepts which are important for genetic analysis. It is proposed to teach this course in an interactive mode and offering in-house examples.

PGEN002- Genetic Toolkits to Study Genes, Development and Diseases (4 credits): This course has been designed to provide a brief overview of the available genetic toolkits to study genes, development and diseases. This course not only provides a notion about the dynamic nature of chromosome and its influence on cellular functioning but also offers an outline of the concepts on the flow of genetic information, development and Evo-Devo with especial

emphasis on *Drosophila* based genetic tools to perform human disease modelling, drug screening, behavioral studies and aging.

PGEN003: Introduction to *Dictyostelium discoideum* (4 credits): The course is designed to provide some fundamental principles to form an integrated view of various genetic and molecular processes in *Dictyostelium discoideum* and to highlight it as a powerful model system. Tutorials would be in the form of assignments, discussions on research and review papers related to each topic, highlighting the advances made in the field.

PGEN004: Introductory Course in Cancer Research (4 credits): This course aims to build a foundation in the basic understanding of cancer research peppered with seminal work from the past and critical advances in the field. Case studies and examples from bench-to-bedside-to-bench will help in understanding the progression of basic cancer research to therapy. We look beyond the basic cancer research and discuss our role as educated and scientifically empowered individuals in the society.

PGEN005- Mitochondrial physiology and its consequences on cellular fitness (4 credits): This is designed to provide some fundamental principles on which to form an integrated view of various genetic and molecular processes using yeast as a model system for studying molecular mechanisms governing mitochondrial function. Tutorials would be in the form of discussion based on primary literature available related to each topic, highlighting the advances in each filed.

PGEN005- Plant-Microbe interactions (4 credits): This course is designed to provide the students insights into the genetic and molecular principles underlying immunity in plants and microbial pathogenesis. The interactions between microbes and plants provide fascinating examples of biological communication. The course design explores the molecular intricacies underlying the host-pathogen relationships, the virulence factors that promote colonization and survival of infecting microorganisms and virulence attributes that damage the host.

PGEN007- Reviewing Regulation of Gene Expression (4 credits): This course while revisiting the different strategies used for regulating the expression of a gene, would emphasize on the various approaches to analyze the strategies and how this knowledge can be used in biotechnological approaches.

Paper- PGEN001

Research Methodology

(4 credits)

Duration: 60 hrs. **Marks:** 100

This paper aims to introduce different aspects of research methodology and also to revisit the concepts which are important for genetic analysis.

Revisiting concepts for genetic analysis: variations, segregation, independent assortment, gene interactions, linkage, recombination and genetic maps [10]

Identifying a broad research area: Basic versus applied; Narrowing down to a sub-area [2]

Relevant scientific literature search: Importance and methods (including choice of key words); Learning to distinguish between original work, repetitive work and validation study [2]

Framing a research question: Identification of lacunae in the research area of interest; Hypothesis generation; defining the aims/objectives; Revising objectives at a later date [2]

Designing a realistic research strategy including alternate strategy; Study design, Importance of - inclusion of negative and positive experimental controls, biological and technical replicates, single and double blind studies, coding/anonymisation of samples, statistics based sample size determination prior to finalization of study design [6]

Recording observations: Importance; Methods of transparent and systematic record keeping; Maintenance of laboratory work books – hard and soft copies; Storage of data including taking regular backups [4]

Organization and analysis of observational/experimental data: Hypothesis testing, hypothesis generation, unbiased analysis, importance of looking beyond the obvious, serendipitous findings, independent cross-validation of data; Interpretation of data [6]

Presentation of data: Raw and analyzed data; Methods- Graphic, pictorial, tabular, oral, poster [10]

Scientific writing: Abstract, synopsis, concept note, full length research proposal, research paper, research thesis; Importance and styles of citing references [12]

Safety in research: Handling of biohazardous substances, disposal of biohazardous waste; Biosafety issues- Chemical, radiation, recombinant DNA, biological material [2]

Debatable issues in applied research: Genetically modified foods; Ethical, legal and social issues in biomedical research [2]

IPR issues in research [2]

Paper- PGEN002

Genetic Toolkits to Study Genes, Development and Diseases

(4 credits)

Course Instructor: *Dr. Surajit Sarkar*

Duration: 60 hrs. **Marks:** 100

This course has been designed to provide a brief overview of the available genetic toolkits to study genes, development and diseases. This course provides a notion about the dynamic nature of chromosome and its influence on cellular functioning. Along with, the students will get an outline of the concepts on the flow of genetic information, development and Evo-Devo. This course also provides an advanced understanding about contemporary Drosophila genetics and related areas. Students are expected to not only develop an inclusive concept on classical and contemporary fly-based genetic toolkits but also study the relevance of Drosophila in human disease modelling, drug screening, behavioral studies and aging.

Concept of chromosomes, genes and genome: A brief history and present status. [12]

The flow of genetic information: Brief overview of rules and regulations. [4]

Concept of development: The complexities and unexpected insights. [4]

Evo-Devo: Discovery of diverse mechanisms regulating development. [4]

***Drosophila* - a century old model system to comprehend genes, development and diseases:** life history; imaginal discs, overview of gametogenesis, classical and contemporary tools (P-element, FRT/FLP; UAS/Gal4/Gal80; CRISPR-Cas9 etc.) to study genes and development; Somatic and germline stem cells, Modeling of human neurodegenerative disorders (i.e. Parkinson's, Huntington's, Alzheimer's diseases etc.), cancer, mitochondrial dysfunction etc. Screening and identification of modifier genes, drug targets and drug molecules. Usages of *Drosophila* in behavioural genetics and aging research. [32]

Discussion on some breakthrough research papers. [4]

Paper- PGEN003

Introduction to *Dictyostelium discoideum*

(4 credits)

Course Instructor: *Dr. Aruna Naorem*

Duration: 60 hrs. **Marks:** 100

The course is designed to provide some fundamental principles to form an integrated view of various genetic and molecular processes in Dictyostelium discoideum and to highlight it as a powerful model system. Tutorials would be in the form of assignments, discussions on research and review papers related to each topic, highlighting the advances made in the field

Brief introduction: An overview; *Dictyostelium discoideum* and its life cycle - unicellular and multicellular phases. [4]

History of research on *D. discoideum*: Classical experiments of Kenneth Raper; Chemotaxis and aggregation; Molecular techniques. [8]

Multicellular development: Transition from growth to development, detection of starvation, events after starvation, Cellular and molecular mechanisms; Factors controlling early development, Cell adhesion molecules, cell-cell contact and gene expression; Cell recognition in the sexual development, Cell differentiation and Pattern formation, coordinated cell movement and Morphogenesis, Cell fate determination. [20]

Signal transduction: Diffusible molecules; cAMP signaling, cAMP oscillation and signal relay, control of aggregation, cell sorting, coordinated cell movement during multicellular morphogenesis; Prespore gene expression; Peptide signaling; Spore and Stalk differentiation. [16]

***D. discoideum*:** a model system for biomedical research. [12]

Paper- PGEN004

Introductory Course in Cancer Research

(4 credits)

Course Instructor: *Prof. Tapasya Srivastava*

Duration: 60 hrs **Marks:** 100

This course aims to build a foundation in the basic understanding of cancer research peppered with seminal work from the past and critical advances in the field. Case studies and examples from bench-to-bedside-to-bench will help in understanding the progression of basic cancer research to therapy. We look beyond the basic cancer research and discuss our role as educated and scientifically empowered individuals in the society.

Basic cancer biology - Cellular changes in tumor onset and progression; Molecular signaling in cancer; Hallmarks of cancer; Frequently used nomenclature in cancer research [10]

Genetic basis of cancer onset and progression - Theories on cancer onset and progression; Experiments that explained genomic instability – seminal work; Tumor suppressors, oncogenes and repair system; Experiments that determined the role of tumor suppressor genes, oncogenes and repair pathways; Epigenetics - DNA methylation, non-coding RNA and protein modifications; Experimental analysis of the epigenetic changes associated with cancer onset [20]

Conducting research on cancer - Understanding various disease models used for cancer research; Commonly used experiments in research for cancer therapy; Examples of lab-to-clinic work in cancer research; Standard-of-care therapies – mode of action; Invited lectures [10]

Current trends in cancer research - Recent path-breaking advances in cancer research; New therapies in development; On-going research paper discussion [10]

Cancer and society - Understanding roles of various care-giver; Our role as educated citizens; Communicating cancer research to the public [10]

Paper- PGEN005

Mitochondrial physiology and its consequences on cellular fitness

(4 credits)

Course Instructor: *Dr. Kaustuv Datta*

Duration: 60 hrs. **Marks:** 100

The course is designed to provide some fundamental principles on which to form an integrated view of various genetic and molecular processes using yeast as a model system for studying molecular mechanisms governing mitochondrial function. Tutorials would be in the form of discussion based on primary literature available related to each topic, highlighting the advances in each filed.The detailed contents of the course would vary depending upon the background of the students taking this course and their specific requirements in doctoral work.

Saccharomyces cerevisiae as a hotbed for discovery of basic biological process: Life with 6000 genes; post-genomic era - genome-wide microarrays, proteomics, genome-wide protein localization; Synthetic gene array analysis, SC2.0 [8]

Mitochondrial Physiology: Mitochondrial dynamics; Mitochondrial control by nuclear genome: Mitochondrial retrograde signaling: Mitochondrial gene expression: links to cellular life span. [12]

Transcriptional and translational control by nutrition: Amino acid starvation and TOR signaling, glucose repression and de-repression. Control of mitochondrial gene expression. [12]

Metabolic switching and adaptation: principles governing cellular heterogeneity; concepts of bet-hedging; contribution of mitochondria to these events; connection between *Saccharomyces cerevisi*ae and pathogenic cell state. [20]

Saccharomyces cerevisiae as a model for pathogenic yeast: similarities and differences; unique features of mitochondrial system in pathogenic organisms. [8]

Paper- PGEN006

Plant-Microbe interactions

(4 credits)

Course Instructor: *Prof. Jagreet Kaur*

Duration: 60 hrs. **Marks:** 100

Pathogenic microbes are a global threat not only to human health but also to food production and quality. With the ever-increasing demand to improve agricultural yields to keep up with the global food demand this area of host – microbe interaction is becoming more and more important for sustainable agriculture. This advanced course is designed to provide the students insights into the genetic and molecular principles underlying immunity in plants and microbial pathogenesis. The interactions between microbes and plants provide fascinating examples of biological communication. The course design explores the molecular intricacies underlying the host-pathogen relationships, the virulence factors that promote colonization and survival of infecting microorganisms and virulence attributes that damage the host.

Introduction: A historical perspective, significance of plant health, current challenges to sustainable crop production and introduction to central concepts underlying host-microbe interactions, molecular Koch's Postulates**.** Studying the infection processes and specificity of pathogens and their host range, Disease cycle and epidemics. [8]

Model pathosystems used in plant pathology: Arabidopsis – *Pseudomona syringae*, - Potato –*Phytophthora infestans* [4]

Research tools used to study host- microbe interaction Genomic tools, molecular and cellular genetics, imaging for bacteria, fungi and oomycetes. [12]

Molecular basis of Microbial pathogenesis: Strategies deployed for pathogenesis, symbiosis, commensalisms and mutualism; Virulence factors, Gene for gene Model, molecular Koch's Postulates; Repertoire of effectors and their actions in pathogenesis; generation of variability. [16]

Molecular and cellular basis of plant defense: Non-host resistance, Plant innate immunity, Pre-formed inhibitors of pathogen invasion, Types of plant resistance – vertical and horizontal, R genes (quantitative and monogenic resistance); molecular mechanisms underlying basal and induced defense responses and systemic acquired resistance. [16]

Disease resistance in agricultural contexts
Translational research advances and potentials**:** Biotechnological approaches. [4]

Paper- PGEN007

Reviewing Regulation of Gene Expression

(4 credits)

Course Instructor: *Prof. Pradeep Kumar Burma*

Duration: 60 hrs. **Marks:** 100

This course builds on the foundation laid at the Master's level. The course while revisiting the different strategies used for regulating the expression of a gene, would emphasize on the various approaches to analyze the strategies and how this knowledge can be used in biotechnological approaches. The detailed contents of the course would vary depending upon the background of the students taking this course and their specific requirements in doctoral work.

Levels of regulation of gene expression; epigenetic, transcriptional, post-transcriptional, translational, post-translational etc. – A recap. [8]

Building constitutive, inducible and repressible gene expression systems using positive and negative regulators. [12]

Gene regulatory networks. [8]

Strategies to analyze different components of regulation. [20]

Approaches to achieve optimal levels of expression of heterologous genes in prokaryotic and eukaryotic systems. [12]

Department of Germanic and Romance Studies
University of Delhi
Coursework for Ph. D Programme

The duration of the Ph.D. coursework is of one year, spread over two semesters. In the First semester, which will comprise of minimum 3 months and maximum 4 months, students will have to complete 2 courses (Total 6 credits) and in the second semester, comprising of 8 months, students will have to opt for 2 optional Courses (Total 8 Credits).

Students may be admitted to the Ph.D. Programme in the following areas:

- **French Studies**
- **German Studies**
- **Hispanic Studies**
- **Italian Studies**
- **Portuguese Studies**

The course work has been designed to equip students enrolled in the above-mentioned disciplines to conduct analytical, exploratory, or empirical research on the following thrust areas:

- Contemporary Europe and the Postcolonial World
- Foreign Language Education
- Theory and Practice of Translation

The coursework will enable students to critically engage with the methodological tools available to undertake research on all three areas of investigation with an interdisciplinary and comparative framework.

Course structure

Semester	Paper No.	Course Title	Credits
I	101	Research and Publication Ethics	2
	102	Research Methodology	4
II	201	Optional 1: Methodology of Teaching a Foreign language	4
	202	Optional 2: Interdisciplinary Perspectives in Theory	4
	204	Optional 3: Engaging with Texts	4
			14

Course 101: Research and Publication Ethics (2 Credits - 2 lectures/week)

Course Objectives:

This course will introduce students to the ethical questions related to research work and publication. Students will be introduced to basics of philosophy of science and ethics, research integrity, publication ethics so that students are aware of malpractices pertaining to research and publication.

Course Learning Outcomes:

- Students will learn to provide ethical and moral justifications about relevance, aims and objectives of the research.
- Students will develop the awareness about his/her responsibility as a researcher
- Students will be able to identify predatory publications as well as misconduct/malpractices in the field of research and publication.
- Students will develop an in-depth knowledge about Indexing and citation databases, open access publications, research metrics (citations, h-index, impact factor, etc.).
- Students will develop an awareness about plagiarism tools and issues related to plagiarism so that they can stay away from malpractices in the fields of research and publication

Co**urse Content**

Unit 1: Philosophy and Ethics (4 Hours)

- ⇒ Introduction to Philosophy: definition, nature and scope, concept, branches
- ⇒ Ethics: Definition, moral philosophy, nature of moral judgments and reactions.

Unit 2: Scientific Conduct (4 Hours)

- ⇒ 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

Unit 3: Publication Ethics (7 Hours)

- ⇒ 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
- ⇒ Practice

Unit 4: Open Access Publishing (4 Hours)

- ⇒ 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.

Unit 5: Publication Misconduct (4 Hours)

- ⇒ Group discussions
- ⇒ Subject specific ethical issues, FFP, authorship
- ⇒ Conflicts of interest
- ⇒ Complaints and appeals: examples and fraud from India and abroad

⇒ Software tools
⇒ Use of reference management software like Mendeley, Zotero etc. and anti-plagiarism software like Turnitin, Urkund, Drillbit

Unit 6: Databases and research metrics (7 Hours)

⇒ 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, i-10 index, altmetrics

Assessment: Assessment will comprise of one Presentation and one written assignment. To be conducted in English.

References

Bird, A. (2006). *Philosophy of Sciences*. London: Routledge.
London, J. A., (2022). *For The Common Good: Philosophical Foundations Of Research Ethics*. New York: Oxford University Press.
MacIntyre, A. (1966). *A Short History of Ethics*. London: Macmillan.
Oliver, P. (2010). *The Student's Guide to Research Ethics*, Berkshire: Open University Press.
P. Chandah. (2018). Ethics in Competitive Research: Do not get Scooped; do not get plagiarized.

Course 102: Research Methodology (4 Credits - 4 lectures/week)

Course Objectives: This course will help students to understand the basics of carrying out research in the Humanities. They will be appraised of various methods and techniques of planning, designing, and conducting research pertaining to the Humanities. It will enable students to communicate effectively in oral and written form using an appropriate logical structure and adhere to the conventions of scholarly expression, presentation, and referencing.

Course Learning Outcomes:

- Students will be introduced to various types of research methods related to the Humanities.
- Students will be able to engage with critical debates related to various interdisciplinary research methods related to the Humanities
- Students will be able to plan, design and conduct their research in the area of the Humanities.
- Students will develop skills in qualitative and quantitative data analysis and presentation.
- Students will be able to demonstrate the ability to choose methods appropriate to their research objectives.

Course Content

Unit 1: Defining the Field of the Humanities (4 hours)

⇒ What is Interdisciplinary Humanities?
⇒ Basic features of research in the Humanities
⇒ Research in the Science vs research in the Humanities

Unit 2: Theoretical Debates in the Humanities (6 hours)

⇒ From New Criticism to Structuralism
⇒ Post-Structuralism and Deconstruction
⇒ Reception Theory
⇒ New-Historicism
⇒ From Postcoloniality to Decoloniality
⇒ Eco-Criticism

⇒ Gender, Feminist and Queer studies
⇒ Comparative Studies and Translation Studies

Unit 3: Analytical Tools (6 hours)

⇒ Textual analysis
⇒ Critical Discourse Analysis
⇒ Hermeneutic Analysis

Unit 4: Data Collection (6 hours)

⇒ Sources of Data: Primary and Secondary
⇒ Methods of collecting data: Observation, Questionnaire, Interview, Focus groups and Case study method
⇒ Types of Sampling: Random sampling, Systematic sampling and Stratified sampling
⇒ Survey Research: Role of library and Internet
⇒ Literature review

Unit 5: Research planning and designing in the Humanities (4 hours)

⇒ Choosing a research topic
⇒ Turning a research topic into a researchable question
⇒ Stating the Hypothesis
⇒ Structuring the thesis
⇒ Practical aspects of thesis writings
⇒ Referencing and referencing styles

Assessment:

Assessment will be based on the preparation of an annotated bibliography related to the research area of the student (It should comprise of at least 10 books/book Chapters and 5 articles) along with at least one presentation as well as one discussion.

References:

Deshpande, H.V. (2018), *Research in Literature and Language*, Chennai: Notion Press.

Eliot, S., Owens W.R. (1998), *A Handbook to Literary Research.* London: Routledge in association with the Open University.

Garner, M., Wagner, C. and Kawulich, B. (eds.) (2009), *Teaching research methods in the social sciences.* Farnham: Ashgate Publishing, Ltd.

Griffin, G. (ed.) (2005), *Research Methods for English Studies*. Edinburgh: Edinburgh University Press.

Mahoney, K. and Brown, R. (2013), Devising and Interdisciplinary Teaching: A Case Study in Collaboration Between Theatre and Humanities Courses, *College Teaching*, Vol. 61, No. 4, pp. 143-149.

Parker, J. (2003), Writing, revising, and practicing the disciplines, *Arts and Humanities in Higher Education*, Vol. 2, No. 2, pp. 139-153.

Pickering, M. (2008), *Research Methods for Cultural Studies.* Edinburgh: Edinburgh University Press.

White, P. (2013), Who's afraid of research questions? The neglect of research questions in the methods literature and a call for question-led methods teaching, *International Journal Of Research & Method In Education*, Vol. 36, No. 3, pp. 213-227.

Saldanha G., O'Brien S. (2014) *Research Methodologies in Translation Studies*. New York: Routledge.

Saukko, Paulo. (2003), *Doing Research in Cultural Studies*, London, Thousand Oaks, New Delhi: Sage Publications.

Optional Course I- 201: Methodology of Teaching a Foreign Language (4 Credits - 4 lectures/week)

Course Objectives: The course will include both Theory and Practice of methodology of teaching Foreign Languages (FL) to impart necessary know-how to become foreign language teachers.

Course Learning Outcomes:
-Students will develop an understanding of theory and practice of foreign language teaching.
-Become aware of the methodologies and develop a holistic perspective on teaching/ learning of foreign languages in general and specifically in an Indian context.
-Develop theoretical frameworks regarding various pedagogical practices of foreign language teaching/ learning in Indian context as well as a comparative perspective in foreign language teaching/ learning in wider context.
-Acquire necessary abilities to instruct and teach in foreign languages under study.

Course Content:

Unit 1: Foreign Language Classroom: Observation and Analysis (5 hours)

- ⇒ study the general features of Teaching/ Learning experience in FL classrooms and their specificities.
- ⇒ identify key issues of FL teaching/ learning.
- ⇒ identify effects of classroom interaction including teacher's conduct, identify students' attitudes, aptitudes, etc.
- ⇒ Learn the necessity as well as the techniques of class observation and reflection etc.

Unit 2 Learner and Learning Process (5 hours)

- ⇒ Learn multiple theories about second language acquisition.
- ⇒ explore the different teaching methodologies that are applied in Foreign Language teaching focusing on several key principles of FL teaching and learning.
- ⇒ study different theories on concepts of motivation, affective factors, learner and learning strategies, interlanguage, interculture and multiculturalism, etc.
- ⇒ Reflect on other current methodologies of FL teaching.

Unit 3 Learning and teaching Methodologies (8 hours)

- ⇒ Appraise the historical trajectory of different methods and approaches of a FL teaching.
- ⇒ Study learner centered methodologies such as Communicative Approach of Teaching FL, identify communicative competences; learn characteristics of Communicative Approach; Reflect on paradigmatic shift of Fl teaching focusing on Communicative approach activities.
- ⇒ Examine/ reflect on Common European Framework of Reference for Languages with reference to the Fours/ Five Skills, Language Levels, and communicative competences and learning strategies.

Unit (4) Pedagogical Practices of FL teaching in classrooms: (8 hours)

- ⇒ Develop a discursive awareness of how the target language works as well as understand the terminology used in teaching materials and reference books.
- ⇒ Learn the use of a variety of techniques for working with vocabulary, grammar and pronunciation in the communicative classroom and integrate vocabulary, grammar and pronunciation into the communicative lesson through practice activities.

⇒ Learn to make daily/ weekly Lesson Plans, develop courses/ syllabus of FL courses.

⇒ Evaluate teaching materials, select appropriate material, create and adapt it to the communicative classroom.

Unit 5 Theory and Practice of Evaluation: (6 hours)

⇒ Study the key principles of assessment and evaluation within the framework of Communicative Language Teaching.

⇒ Identify different features and purposes of evaluation tools and procedures with reference to the particularities of the Indian classroom.

⇒ Discern and develop different criteria for different modes of evaluation.

Assessment

Assessment will be based on practical components such as Classroom Observation, Preparation of a Lesson Plan and a mock teaching unit. Modules on evolution of various methodologies and approaches of teaching to be done in English. Techniques of teaching of various competences, classroom observation and mock teaching unit to be done in respective sections/languages.

References:

- Aitchison, J. (2012). *Words in the mind. An Introduction to the Mental Lexicon*. London: Wiley Blackwell.
- Cornbleet, S. & R. Carter (2001). *The Language of Speech and Writing*. London: Routledge.
- Dornyei, Z., (2003), *Attitudes, Orientations and Motivations in Language Learning*. Blackwell.
- Lasagabaster, David and Juan Manuel Sierra (2011), Classroom observation: desirable conditions established by teachers, *European Journal of Teacher Education*, Vol 34, No. 4, Nov 2011, 449-463Richards, J., Rodgers, T., (2014), *Approaches and methods in language teaching*. Cambridge, Cambridge University Press.
- Rost, M. (2002), *Teaching and Researching Listening*. Harlow: Longman, Pearson Education
- Ur, P., (1996), *A Course in Language Teaching: Practice and Theory*. Cambridge: Cambridge University Press
- VanPatten Bill, Keating Gregory D., et al (2020) *Theories in Second Language Acquisition: An Introduction,* Routledge, New York
- Wajnryb, R., (2002), *Classroom Observation Tasks: A Resource Book for Language Teachers and Trainers*, Cambridge: Cambridge University Press
- Council of Europe, (2000). *Common European Framework of Reference for Languages: learning, teaching, assessment. Council of Europe*. Cambridge: Cambridge University Press. http://www.coe.int/t/dg4/linguistic/CADRE_EN.asp

Optional Course II-202: Interdisciplinary Perspectives in Theory (4 Credits - 4 lectures/week)

Course Objectives: This course will expose the students to the concepts and theoretical frameworks from different disciplines such as literature, visual and performance studies, the social sciences, cultural studies, translation studies, comparative studies etc. It will be held in English and will offer an opportunity to Ph.D. students to come together to critically engage with various literary and cultural theories relevant in the humanities in an interdisciplinary manner.

Course Learning Outcomes:

- provide students with an understanding of concepts, relevant theoretical frameworks and multiple approaches in the study of Literary, Cultural, Comparative and Translation Studies.
- expose students to multiple worldviews and foster skills in close reading and critical analysis
- students develop the capacity to study, analyse and compare varied cultural and literary forms in an interdisciplinary manner.

Course Content:

Semester I

Unit 1: Problematising Representation (4 Hours)

- ⇒ Coloniality, postcoloniality, decoloniality
- ⇒ Nation, nationhood, nationalisms and Imaginary Homelands
- ⇒ Exile, diaspora, borders and margins
- ⇒ Power Relations, Political "Othering,", problematising issues of cultural identity

Unit 2: Understanding Gender (4 Hours)

- ⇒ Questions of Category: Sex-Gender-Sexuality
- ⇒ Deconstructing Eurocentric Feminist enquiries: Postcolonial, Afro, Arab, Latino Feminism and Womanism
- ⇒ Defining queerness
- ⇒ Intersectionality and Gender
- ⇒ Essentialism, Anti-Essentialism, Strategic Essentialism
- ⇒ Post-feminism, Posthumanism, Nomadism

Unit 3: Understanding Race, Class and Caste (4 Hours)

- ⇒ Socio-economic stratification in the society and how power is constituted
- ⇒ Socio-political alterity imposed along the fault lines of caste, class and race
- ⇒ Commonalities and differences of each of the categories
- ⇒ Strategies of resistance to counter racist, classist and casteist oppression and discrimination

Unit 4: Questioning Language, Discourse and Ideology (4 Hours)

- ⇒ Language- text- discourse
- ⇒ Politics of discourse, discursive and ideological formations
- ⇒ Narrative discourse- voice and identity
- ⇒ Semiotics-sign-symbols
- ⇒ Deconstruction

Unit 5: The text and the reader (4 Hours)

- ⇒ Readerly and Writerly Texts
- ⇒ Interpretive communities
- ⇒ Reader response theory
- ⇒ Reception Theory
- ⇒ Phenomenological readings of texts and contexts

Unit 6: Understanding the Subject (4 Hours)

- ⇒ Freudian Psychoanalysis
- ⇒ Jung: Collective unconscious
- ⇒ Lacan : Real-imaginary-symbolic
- ⇒ Fanon: Postcolonial criticism of Freud
- ⇒ Mélanie Klein: Feminist criticism of Freud
- ⇒ Zizek: Recent trends in Psychoanalysis

Unit 7: History and Memory (4 Hours)

- ⇒ Development of memory studies

- ⇒ Social and collective memory
- ⇒ Sites of memory
- ⇒ Cultural and Communicative memory
- ⇒ History, time and forgetting
- ⇒ Gender and memory

Unit 8: Comparative Literature and Translation Studies (4 Hours)

- ⇒ World Literature-Littérature monde-Worldlings
- ⇒ Theories and practices of textual analysis and comparative textual analysis
- ⇒ Major debates about theories and practices of comparative literature in a transnational context.
- ⇒ Theories on translation from the perspective of its intersections with cultural studies and philosophy.
- ⇒ Ontological and epistemological underpinnings of key theoretical frameworks used in translation studies: equivalence and authorised translation; paratexts; translation and gender; Cultural positioning and social narrative; geopolitics and translation

Assessment:

Each student will be required to make 2 presentations and 2 discussions (50% weightage). At the end of the semester, the student will be required to present the final draft of her synopsis in an open seminar (50% weightage). The final synopsis will be evaluated by the Research Advisory Committee of the student.

References:

Bill, A., Griffiths, G., Tiffin, H., eds., (1989), '*The Empire Writes Back: Theory and Practice in Post-Colonial Literatures*. New York: Routledge.

Bulmer, M., Solomos, J., eds., (1999), *Racism: Oxford Reader*. New York: Oxford University Press.

During, S., (2007). *The Cultural Studies Reader*. London: Routledge.

Hutchinson, J., Smith, D. A., eds., (1994). *Nationalism: Oxford Reader* London: Oxford University Press.

Mukherjee, T. (2013). *Companion to Comparative Literature, World Literatures, and Comparative Cultural Studies*. Delhi: Cambridge University Press club.

Philip, R., Waugh P. (2001), *Modern Literary Theory: A Reader*. New York: Hodder Arnold.

Rivkin, J., Michael, R., eds. (2004) *Literary Theory: An Anthology*. London: Blackwell Publishing Ltd.

Venuti, L., (2021). *The Translation Studies Reader*. London: Routledge.

Walder, D., ed. (2004). *Literature in the Modern World: Critical Essays and Documents*, Second Edition. New York: Oxford University Press.

Optional Course III- 203: Engaging with Texts (4 credits - 4 lectures/week)

Course Objective: The course will help students to identify and review secondary literature pertaining to their area of interest and develop a critical framework for their research.

Course Learning Outcomes:

- Students will be able to critically engage with pertinent theoretical texts related to their area of interest.

- Students will develop an in-depth knowledge of reading strategies and analytical tools to study theoretical texts and discourses and apply them.

- Students will be able to conduct literature review in their area of interest and can identify useful resources for their area of interest

Course Content:

Semester 1

Unit 1: Critical Reading Strategies (8 hours)

- ⇒ Genealogical Reading
- ⇒ Deconstruction
- ⇒ Hermeneutic Reading: Reader Response Theories
- ⇒ Reception and Influence Theories
- ⇒ Critical Discourse Analysis

Unit 2: Historical overview of the field of research (8 hours)

- ⇒ Study of representative texts defining the field
- ⇒ Study of Initial debates pertaining to the field

Unit 3: Contemporary critical issues emerging in the field (8 hours)

- ⇒ Study of the most recent debates emerging in the field
- ⇒ Survey of the evolving critical issues within a given field to understand their progression

Unit 4: Developing Critical Framework for Ph.D. research (8 hours)

- ⇒ Identifying critical tools required to conceptualise the doctoral research
- ⇒ Critical analysis of theoretical texts relevant to the doctoral research

Assessment

The assessment will comprise of discussions on texts relevant to the topics chosen for research. It will include two detailed presentations in the concerned language based on a survey of relevant secondary literature. The presentations are to be submitted subsequently in writing. To be conducted in respective languages by the supervisors.

References:

Friedrich, Jasper (2022). *Philosophy from the Texture of Everyday Life: The Critical-Analytic Methods of Foucault and J. L. Austin*. *Foucault Studies*.

Holub, R. C. (1992), *Crossing borders: Reception theory, poststructuralism, deconstruction*. Madison, Wis: University of Wisconsin Press.

Koopman, C. (2013), *Genealogy as Critique: Foucault and the Problems of Modernity*, Bloomington: Indiana University Press.

Lazar, M. M. (2005), ed. *Feminist Critical Discourse Analysis*. London: Palgrave Macmillan UK.

Locke, T. (2004), *Critical discourse analysis*. London: Continuum.

Norris, C., (2004), *Deconstruction*. London: Taylor & Francis Inc.

Weiss, G. and Ruth W., eds. (2003), *Critical Discourse Analysis*. London: Palgrave Macmillan UK.

Richter, D. H. (1994), *Falling into theory: Conflicting views on reading literature*. Boston: Bedford Books of St. Martin's Press.

Silverman, J. H., Don, I., eds. (1985), *Hermeneutics & deconstruction*. Albany: State University of New York Press.

Todd F. D. (2002)., *Formalist criticism and reader-response theory*. Houndmills, Basingstoke, Hampshire: Palgrave.

Toolan M., ed. (2002), *Critical discourse analysis: Critical concepts in linguistics*. New York: Routledge.

SYLLABUS FOR Ph.D. COURSE WORK

DEPARTMENT OF PLANT MOLECULAR BIOLOGY
FACULTY OF INTERDISCIPLINARY & APPLIED SCIENCES
UNIVERSITY OF DELHI, SOUTH CAMPUS
NEW DELHI – 110 001
INDIA

DEPARTMENT OF PLANT MOLECULAR BIOLOGY
FACULTY OF INTERDISCIPLINARY & APPLIED SCIENCES
UNIVERSITY OF DELHI SOUTH CAMPUS

SYLLABUS FOR Ph.D. Course Work

The department offers two papers (PMB I and PMB II) for Ph.D. course work. These two papers are also open for students from other departments under FIAS. Each paper will be of 4 credits and the credit assigned to Ph.D. course work shall be a minimum of 8 credits and a maximum of 16 credits. The Ph.D. students of Department of Plant Molecular Biology can also opt for courses in allied subjects being offered by other departments affiliated to FIAS. A student shall be required to complete the coursework within initial one or two semesters. A paper on 'Research Methodology' is compulsory. The courses to be opted by students in each semester should be in consultation with the Research Advisory Committee and with concurrence of the Departmental Research Committee (DRC).

Details of Papers:
The research methodology paper is based on literature survey, instrumentation, core techniques in molecular biology, computer application, data search, and presentation and writing skills. The other course is aimed at introducing the students to advances in the field of plant molecular biology and plant biotechnology.

S. No.	Code of the Paper	Name of the Paper
1.	PMB I	Research Methodology
2.	PMB II	Advances in Plant Molecular Biology and Biotechnology

Evaluation Criteria:
The papers will have components of end-of-semester examination and continuous evaluation or internal assessment. The criteria for internal assessment shall be decided by the Coordinator and the teachers involved in teaching the respective courses. Students shall be required to attend a minimum of two-third of the lectures delivered in individual papers. The maximum marks for each paper are 100 and a student must score at least 55 marks to pass a paper. The distribution of marks is as follows:

		Maximum Marks (100)	
Code of the Paper	**Offered in Semester**	**End-of-semester Examination**	**Internal Assessment**
PMB I	Semester I (July-Nov)	70	30
PMB II	Semester II (Jan-May)	70	30

PMB I: RESEARCH METHODOLOGY

1. **Instrumentation** -- Basic techniques in Microscopy, Spectroscopy, Spectrometry, Centrifugation, Electrophoresis (gel and chip), Biacore, Gene gun (biolistic), related topics. *8 lectures*

2. **Core Techniques of Molecular Biology** -- Cloning vectors, Cloning methodologies, PCR and its modifications, Gene expression studies, Bimolecular interaction studies, Next Generation Sequencing (NGS) methodologies, Protein sequencing, related topics. *12 lectures*

3. **Literature Survey** -- Reading and interpretation of research papers, Critical analyses of research problems, Research design, Sampling, Patent search, related topics. *3 lectures*

4. **Computer Applications** -- Basics of Computer Operating System: basics of UNIX and Linux commands, Using Windows, Directory structures, Command structure (Document preparation, EXCEL, Power Point Presentation), Scientific editing tools, related topics. *6 lectures*

5. **Database Search & their Utilities** -- Data mining and analysis, preparation and interpretation. *2 lectures*

6. **Introduction to Biostatistics** -- Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis, Cross tabulations, t-test, Chi-square test, correlation, SPSS, p-value, ANOVA (analysis of variance), cluster analysis, related topics. *8 lectures*

7. **Presentation Skills** -- Oral and written presentations, Hand-outs and Brochures, Paper and grant writing skills, Thesis writing tutorials, Project work (drafting a research paper or a project work), related topics. *4 lectures*

8. **Ethics in Science** -- Copyright, Royalty, Intellectual property rights and Patent laws, Reproduction of published material, Plagiarism, Citation and acknowledgements, Reproducibility and accountability, Conflict of Interest, related topics. *5 lectures*

9. **Research Seminars on Related Topics** *14 lectures*

PMB II: ADVANCES IN PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

1. **Unifying Concepts in Light and Hormone Signal Transduction in Plants** -- Diversity of sensory receptors and their evolutionary significance; Two-component sensor-regulator system; Light- and hormone-regulated signaling. *5 lectures*

2. **Forefronts of Calcium Signal Transduction in Plants** -- Calcium as "Hub and Nodal point" in multiple signaling (biotic and abiotic stress); Development of calcium signaling networks with advanced tools and techniques. *5 lectures*

3. **Plant Development** -- Model systems; Developmental differences between animals and plants; Early plant embryogenesis. Patterning and molecular mechanisms of differentiation. *5 lectures*

4. **Gene Regulatory Networks Controlling Flower Development** -- ABCDE model of flower development; Floral initiation and meristem specification; Male and female reproductive development. *5 lectures*

5. **Bioinformatics** -- Biological Databases; Sequence alignment, phylogenetic analysis; Generation and analysis of whole genome data, Whole genome annotation taking examples of major plant genomes. *5 lectures*

6. **Small RNA-mediated Gene Regulation** – Types of non-coding RNAs: Sequencing, detection and validation, Mechanism of action and biological roles; Artificial microRNA (amiR) and siRNA technology. *5 lectures*

7. **Plant Biotechnology and Production of Transgenics for Resistance to Varied Abiotic Stresses** -- Conventional plant breeding, molecular breeding and transgenic science; Tools and techniques for production of transgenic plants; Developing transgenic plants for resistance/tolerance to abiotic stresses. *5 lectures*

8. **Interaction of Plants with Viruses** -- Organization, functions and dynamics of viral genes; Viral promoters; RNA-interference and viral infections; Viral suppressors and their role in pathogenesis; Virus-induced gene silencing; Development of transgenic virus resistance in crops. *5 lectures*

9. **Regulation of Fruit Ripening and Quality Addition and Role of Plants as Bioreactors** -- Role of ethylene; Genes manipulated for delayed ripening; Improvement of folate, lycopene and flavor compounds. Strategies for high-level expression, down-stream processing; Humanization of plant expressed products, few success stories. *5 lectures*

10. **Molecular Breeding and IPR-related Issues** -- Molecular markers; Marker-assisted breeding (MAB) and molecular-assisted selection (MAS); IPR-related issues, trade marks, copy rights, patents, geographical indicators. *5 lectures*

11. **Research Seminars on Related Topics** *14 lectures*

Dr. B R Ambedkar Center for Biomedical Research

COURSES OFFERED FOR Ph.D. CURRICULUM

2023 onwards

Faculty of Science
University of Delhi
Delhi-110007

Dr. B R Ambedkar Center for Biomedical Research
(Faculty of Science)
University of Delhi

SYLLABUS FOR Ph.D. COURSE WORK

The center in keeping with its inter-disciplinary nature offers the following syllabus for the Ph.D. Course work. There are total of four papers that each student has to clear. Paper IA (Research Methodology), Paper IB (Research and Publication Ethics), Paper II (Basic Tools and Techniques in Biomedical Research), Paper III (Advanced Techniques), and Paper IV (Writing a Research proposal) are compulsory. In Paper III, a student can opt for any two modules.

Overview of the Papers:

The Research Methodology paper has been designed to inculcate a scientific temperament in the student and introduce the basic requirements for being a good and motivated researcher. Emphasis is laid on the need to identify a challenging research topic following an extensive literature survey. Learning how to design simple and complicated experiments, the need for reproducibility, analyses of the data obtained and its significance in moving forward follows this. In parallel, the student is also trained to follow ethical guidelines, display scientific integrity; identify conflict of interest and plagiarism issues while writing scientific documents.

The Paper on Research and Publication Ethics has units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions 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.

The Paper on Tools and Techniques in Biomedical Research focuses on the principles, scope and applications of routine and advanced techniques the student is likely to use in his/her research. This will prepare the student to keep in mind the scope and limitations of each technique that will be useful in designing experiments and interpreting the data.

The Paper on Writing a Research Proposal, prepares the students for writing grant proposals that will be extremely useful following the successful completion of the Ph.D. With a number of post-doctoral fellowships now being offered by leading National and International funding agencies this paper will be beneficial to him/her.

The Optional Paper with an array of modules is in keeping with the inter-disciplinary nature of ACBR. A student can opt for any two. Any student is welcome to attend the courses of other modules as well but will be evaluated on his/her choice of the modules opted at the start of the semester.

Course structure and evaluation criteria:

All the papers will be evaluated at the end of each semester and include internal assessment. The individual teachers as per their chosen criteria will decide the internal assessment. A written exam will be held for Papers I, II, and IIIat the end of the semester. The student has to score at least 50% marks in each paper to qualify the same.

Program Structure

PAPER NO.	Paper Title	End-semester Examination	Internal Assessment	To be offered during
PHBS-I A	**Research Methodology**	**35 Marks**	**15 Marks**	**Ist Semester July -December**
PHBS-1A	**Research Methodology**	**50 Marks Via Student Presentation**	**0**	
PHBS-I B	**Research and Publications Ethics**	**35 Marks**	**15 Marks**	**Ist Semester July -December**
PHBS-II	**Basic Tools and Techniques in Biomedical Research**	**70 Marks**	**30 Marks**	**Ist Semester July -December**
PHBS-III	**Advanced Techniques Modules* (Any Two)**	**35 x 2= 70 Marks**	**15 x 2 = 30 Marks**	**Ist Semester July -December**
	Total Marks		**350 marks**	
PHBS-IV	**Writing a Research proposal & Presentation**	**Research proposal writing 50 marks**	**Presentation and Viva-Voce 50 marks**	**Ist Semester July -December**
	Total Marks		**100 marks**	
Grand Total			**450 marks**	

*** Advanced techniques Modules (Choose any two)**

(i) Understanding the Enzyme kinetics, and Ligand, Protein Structure and Folding Methods.
(ii) Methods for Macromolecular Structure Determination.
(iii) Computational and Molecular Modeling Method.
(iv) Introduction to tools of Genomics Research.
(v) Introduction to Tools of Proteomics Research.
(vi) Prokaryotic and eukaryotic organism as model.
(vii) Techniques in translational research.
(viii) Essential Paradigm in Medicinal Chemistry Research.

PAPER IA: Research Methodology (PHBS-I)

Unit 1. Research Methodology: An Introduction

Objectives and motivation in research, Approaches to scientific research- Experimental vs Theoretical; Descriptive vs Analytical; Fundamental vs Applied; Quantitative vs Qualitative; Conceptual vs Empirical; Survey vs Experimental. Issues and concerns related to scientific investigation; lack of exclusivity of methods of research; Merging of various approaches in practice of scientific research

Unit 2. Defining a Research Problem

Identifying gaps in knowledge through literature mining, identifying area of societal need like health/technology/anticipated crisis such as epidemic, energy, water. Elements for outlining a research problem. Developing an approach strategy, feasibility testing.

This unit will extensively involve students' participation through discussions, assignments, demanding a pilot exercise towards identification of research problems.

Unit 3. Designing of Experiment: Strategies, Planning and Analysis

Selection of research topic and its national and international scenario. Techniques involved in research plan using an illustration, Defining Standard Operating Protocols (SOPs), Research Conditions, Repeatability, reproducibility and reliability of results, Accuracy and Precision, Significant figures with reference to numerical data, Errors and uncertainty analysis. Types of errors: Gross error, systematic error, random error, Statistical analysis of data.

Unit 4. Methods in Biomedical Research

Pilot studies, Clinical Research, Ethical issues in clinical research, Epidemiology: Concepts and methods in the context of illustrative projects (classical examples of epidemiological studies such as leprosy, twin studies), Good clinical research methodology

Unit 5. Laboratory and Safety Practices

Biosafety; Introduction to occupational health and safety (chemical, biological and radiation), awareness about handling toxic laboratory chemicals, pathogenic microorganisms, and their safe disposal. Idea about labels and Material Safety Data Sheet (MSDS), safety equipment and procedures, Fire extinguishers, First aid kit.

Unit 6. Intellectual Property

Introduction to IPR (Patent, trademarks, copyright, trade secrets), Importance of academia-industry interaction, Marketing of research outcome.

Unit 7. Scientific Documentation

Significance of report writing, steps in report writing, Types of report: Decision-oriented (Technical) and Survey-based report. Guidelines for reviewing draft report format, typing instructions, citing references.

Writing a scientific paper; structuring a manuscript, data representation for effective communication. Journals relevant to Biomedical research and their paper writing patterns could be discussed.

Internal Assessment: Research Paper Presentation (Seminar), assignments, quizzes, written test etc.

In addition, a student has to make a presentation on the lines of the topics covered above which will be graded for 50 Marks.

SUGGESTED READINGS:

1. Research in Education (2005) 10th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd. (ISBN-13: 978-0205458400)

2. At the Bench: A Laboratory Navigator (2005) Barker, K., Cold Spring Harbor Laboratory Press (New York). ISBN: 978-087969708-2.

3. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers. (ISBN-13 / EAN: 9788122415223)

4. Research Methodology: A Step by Step Guide for Beginners (2010) 3rd ed., Kumar R., Pearson Education. (ISBN-13: 978-1849203012)

5. The Craft of Research (Guides to writing, editing and publishing) (2008), Booth, W.C., Colomb, G.G., Williams, J.M., University of Chicago Press, 2008. (ISBN-13: 978-0226065663)

PAPER - PHBS I B: Research and Publication Ethics (RPE)

Course Level:
- 2 Credit Course (30 hrs.)

Eligibility:
- Ph.D. students

Faculty:
- Interdisciplinary Studies

Course Overview:
- This course has a total of 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions 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.

Pedagogy:
- Class room teaching, guest lectures, group discussions, and practical sessions.

Evaluation:
- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

Teaching and Examination Scheme

Course Code	Course Name	Teaching Scheme				Examination Scheme (Weightage)	
		L	T	P	C	Continuous Evaluation or Internal Assessment	End Semester Exam
ACBR-RPE	Research and Publication Ethics	2	0	0	2	30	70

Continuous evaluation shall be done through tutorials, assignments, quizzes, and group discussions.

L: Lecture T: Tutorial P: Practical
C: Credit Hours (1Credit = 15 Hrs.)

Course structure:
- The course comprises of six modules listed in table below. Each module has 4-5 units.

Module/Unit	Unit Title	Teaching Hours
Theory		
Unit 1 (RPE l)	Philosophy and Ethics	4

Unit 2 (RPE 2)	Scientific Conduct	4
Unit 3 (RPE 3)	Publication Ethics	7
Practice		
Unit 4 (RPE 4)	Open Access Publishing	4
Unit 5 (RPE 5)	Publication Misconduct	4
Unit 6 (RPE 6)	Databases and Research Metrics	7
	Total	**30**

Course Learning Outcomes (CLO):

At the end of the course, students will be able to -

1. demonstrate research and publication ethics
2. identify publication misconduct and predatory journals
3. apply different tools for plagiarism check
4. utilize various indexing and citation databases and outline research metrics
5. appraise research integrity

Syllabus in detail

THEORY/TUTORIAL:

Unit 1 (RPE 1): PHILOSOPHY AND ETHICS (3 hrs.)

1. Introduction to philosophy: definition, nature and scope, concept, branches.
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions.
3. History or rationality and contemporary challenges in research, difference between ethics, values and law.

Unit 2 (RPE 2): SCIENTIFIC CONDUCT (5 hrs.)

1. Ethics with respect to science and research. Ethics in reporting experimental results, proper reporting of positive and negative results, use of open access or licensed software tools against pirated software tools.
2. Intellectual honesty and research integrity. Individual and team integrity.
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP).
4. Redundant publications: duplicate and overlapping publications, salami slicing.
5. Selective reporting and misrepresentation of data, diagrams and photographs, reproducibility of data.

Unit 3 (RPE 3): PUBLICATION ETHICS (7 **hrs.)**

1. Publication ethics: definition, introduction and importance.
2. Best practices/ standards setting initiatives and guidelines: Committee on Publication Ethics (COPE), World Association of Medical Editors (WAME), Directory of Open Access Journals (DOAJ), Open Access Scholarly Publishers Association (OASPA), etc.
3. Conflicts of interest.

4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types.
5. Understanding of copyright form, violation of publication ethics, authorship and contributor-ship, legal aspects.
6. Identification of publication misconduct, complaints and appeals.
7. Commercialization of publishing industry, predatory publishers and journals

PRACTICE/PRACTICAL:

Unit 4 (RPE 4): OPEN ACCESS PUBLISHING (4 hrs.)

1. Open access publications and initiatives.
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies.
3. Software tool to identify predatory publications developed by SPPU.
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Unit 5 (RPE 5): PUBLICATION MISCONDUCT (4 hrs.)

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP, authorship.
2. Conflicts of interest, knowledge commons, role of organization in maintaining integrity in research and building moral and ethical values.
3. Complaints and appeals: examples and fraud from India and abroad.

B. Software tools (2 hrs.)

1. Types of plagiarism: direct, self, mosaic and accidental, avoiding plagiarism, consequences of plagiarism, a few case-studies.
2. Use of plagiarism software like Turnitin, Urkund, iThincate, and other open-source software tools.
3. Use of reference management software like Mendeley, Zotero etc.

Unit 6 (RPE 6): DATABASES AND RESEARCH METRICS (7 hrs.)

A. Databases (4 hrs.)

1. Indexing databases: Google scholar, PubMed etc.
2. Citation databases: Web of Science, Scopus, Google-scholar etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, Source Normalized Impact per Paper (SNIP), SClmagoJournal Rank (SJR), Impact Per Publication (IPP)/Raw Impact per Publication (RIP), CiteScore, Journal impact Factor (JIF).
2. Metrics: h-index, g-index, il0-index, Altmetrics.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 20% of the questions will be asked from self-study contents.

Suggested references/study materials:

1. Adil E. Shamoo, and David B. Resnik, Responsible Conduct of Research, Oxford University Press.
2. Gary Comstock, Research Ethics: A Philosophical Guide to the Responsible Conduct of Research, Cambridge University Press.
3. Miro Todorovich; Paul Kurtz; Sidney Hook. The Ethics of Teaching and Scientific Research
4. Robin Levin Penslar, Research Ethics: Cases and Materials, Indiana University Press.
5. Tony Mayer, and Nicholas H. Steneck, Promoting Research Integrity in a Global Environment, World Scientific Publishing.
6. Historical studies like The Monster Study (https://uh.edu/ethicsinscience/Media/Monster%20Study.pdf)
7. Relevant research papers and articles from reputed Journals.

PAPER - PHBSII: Basic Tools And Techniques in Biomedical Research

Unit 1. Spectroscopic techniques and its biomedical application

Absorption Spectroscopy: UV-Vis and IR spectroscopy- Beer's Lambert's Law, Hook's Law, Instrumentation, Application in quantitation of Protein and Nucleic acid samples

Circular Dichroism Spectroscopy- Cotton effect and Basic principle, instrument, Application in elucidation of protein secondary structure

Fluorescence spectroscopy- Principle, Instrument, Stoke's shift, fluorophores- extrinsic and intrinsic, various type of probes, Application in biomolecule quantitation. Basic principle of FRET (Fluorescence Resonance transfer)

NMR - Basic principle, Instrument, Sample preparation, [^{1}H] NMR analysis, troubleshooting **withits biomedical application**

Mass spectroscopic techniques- Basic principle and EI, Instrument, calculate m/z, MALDI-TOF instrument and principle.

Unit 2. Chromatographic techniques:

HPLC, FLPC, RPLC, and *Gel chromatography:* protein, DNA and RNA purification and separation by PAGE, SDS PAGE, and Agarose gel electrophoresis, Sample preparation and trouble shooting.

Unit 3. Centrifugation:

Principle and different types of centrifugations - differential, density gradient and equilibrium.

Unit 4. Techniques involving radioactive elements:

Basic principle, various labels and their energy, radioactivity decay, Concentration vs specific activity, biomedical application, biosafety

Unit 5. Microscopic techniques and its biomedical application:

bright field, dark field, phase contrast, confocal, fluorescence, electron microscopy, infrared and ultraviolet microscopy. Sample preparation and trouble-shooting.

Unit 6. Flow cytometry

Basic Principle, Instrument, Sample preparation and quantitation and trouble-shooting **and its biomedical application.**

Unit 7. Living organisms as tool for research

A. Bacteria: bacterial growth curve, *Handling of bacteria:* laminar flow hoods its principle and SOP, preparation of culture media for bacterial propagation, transformation, competent cell preparation, sterilization and disinfection, identification of contamination and its prevention, disposal of bacterial culture and media.

B. **In-vitro cell culture:** *concept of cell culture:* isolation of cell, maintaining cells in culture medium, cell line contamination, *manipulation of cell culture*: passage and transfection, sterilization of culture room, disposal of cell culture and media, application of cell culture.

Unit 8. Bio-statistical tools for data analysis:

Introduction to Mean, mode, median, mean deviation, Standard deviation, coefficient of variation. Correlation (Karl Passions, Co-efficient of correlation, Rank correlation) and Regression analysis, taking suitable examples from biological data. Probability: Theorems on probability, Binomial and normal distribution. Methods of Sampling of biological data and analysis using various tests of significance for small and large samples (ANOVA and post-hoc analysis).

Internal Assessment: assignments, quizzes, written test etc.

PAPER: PHBS- III: Advanced Techniques

OPTIONAL PAPER (Opt any TWO MODULES from number i to viii)

Module i. Understanding the Enzyme kinetics, and Ligand, Protein Structure and Folding Methods

1. Introduction to enzyme catalysis, Measurement of specific activity, Measurement of kinetic parameters (K_m, k_{cat}, V_{max}) of an enzyme catalyzed reaction and determination of the mechanism of inhibition and activation energy.
2. Measurement of ligand binding kinetics and evaluation of structural and thermodynamic consequences on the enzyme due to binding of the ligand (through ITC, SPR and FRET)
3. Determination of number of binding sites.
4. Denaturation and mechanisms, Chemical-induced and denaturation of studies, Analysis of melting curves, Understanding the effect of a co-solute on proteins and enzymes.
5. Evaluation of thermodynamic parameters (by evaluating ΔG_D^o, ΔS_m& ΔH_m) and understanding various structural probes (of optical methods) that can be used to monitor protein folding.
6. Direct Thermodynamic parameter measurement by DSC (Principle and analysis of curves)

Module ii. Methods for macromolecular structure determination:

1. NMR: Basic principle, Instrumentation, Sample preparation, Chemical Shift, The Nuclear Overhauser Effect, NOESY, COSY, TOCSY NMR analysis, Structure calculations

2. X-ray Crystallography: Principle and techniques of Crystallography, Phasing methods: Isomorphous replacement, Molecular replacement, Multiple anomalous dispersion, Non-crystallographic symmetry and density modifications

3.Single particleCryo-EM: Fundamentals of Cryo-EM; image formation and aberrations, beam-induced motion; classification, refinement and reconstruction of 3D models, sample preparation and practical consideration in Cryo-EM

4. Application of NMR, XRD, and cryo-EM inbiomedical research.

Module iii. Computational and Molecular Modeling Method

Basic bioinformatics: Databases, sequences, sequence alignment-pair wise/multiple, global/local protein family, domain, sequence conservation.

Basic structural elements of protein and nucleic acids: Primary, secondary and tertiary structures of the proteins and DNA, super secondary structure, hairpin, beta-beta units, beta-alpha unit etc. nucleic acid structures.

Analysis of 3D Structures: Adding hydrogens, analyzing H-bonds, analyzing cavities, analysis of atomic contacts etc.

Structural modeling and secondary structure prediction: Structure prediction in ID space, *scoring function*: force fields, knowledge-based potentials, surface area based function, searching procedures: grid search, *Monte-carlo* algorithm, genetic algorithm.
Building Models- homology models, fold recognition, Ab initio methods, modeling side chain conformation, rotamer libraries.

Molecular docking: Protein-protein docking, protein-ligand docking
Molecular motions: Energy minimization methods and conformationalsampling and optimization (grid search, steepest descent, conjugate gradient), molecular dynamics
Drug design: Docking, virtual screening, QSAR, ADMET, drug likeliness etc.

Module iv. Introduction to tools of Genomics Research

1. **Generation of disease models for Biomedical Research**
   Transgenic animals, targeted Knock-out and knock-in, Cre-lox and CRSPR-Cas system, Design of knock-down through siRNA/RNAi
2. **Assessment of genetic manipulation**: example PCR, RT-PCR, qPCR, LAMP
3. **New Generation Sequencing methods.**
4. **Transcriptomics:** Microarray, RNA-sequencing, exome sequencing, exome Chip,
5. **Tools for epigenome analysis**: DNA methylation analysis, Chromatin Immunoprecipitation (ChIP), ChIP-sequencing, Approaches to long range interaction in the genome.

Module v. Introduction to Tools of Proteomics Research

1. **Methods of protein analysis:** Different types of Gel electrophoresis, substrate gel electrophoresis, ELISA, EMSA, Western Blot.
2. **Yeast Two hybrid:** experimental design and strategy, read-outs, and trouble-shooting Application.
3. **Proteome analysis:** 2D-PAGE, Mass spectroscopy for protein: principle, sample preparation handling and trouble shooting, Orbitrap Mass analyser
4. Introduction to software used for protein identification
5. Metabolomics and Lipidomics

Module vi. Prokaryotic and eukaryotic organisms as model.

a) Guide for the selection of appropriate microorganism as model organism- Bacteria, basic maintenance and propagation and storage, methods to identify species by sequencing, disease model based on prokaryotes

b) Guide for the selection of appropriate eukaryotic organism as model organism Yeast, c-elegance, drosophila, mouse, rat, disease model based on eukaryotic animals.
c) **Mouse and rat as research tool:** Animals and their welfare, basic animal handling, breeding and maintenance, understanding of animal behavior, use of anesthesia and analgesia, Euthanasia, Sample size and statistical analysis, administration of drug and animal waste disposal, contamination and infection.
d) **Research ethics for animal and human use for experiments**: animal and human welfare in research, justification of research, skill of personnel conducting the research, *experimental procedures and its rationale:* choice of biological fluid withdrawal and route of drug administration.

Module vii. Techniques in translational research

a) **Techniques in physiology:** ECG- basic cardiology and analysis of ECG, General organization of brain, receptors, neuro-transmitters, and analyses of EEG, General muscle physiology and EMG analyses.
b) **Techniques in Behavioral pharmacology and toxicology:** Acute toxicity, LD_{50}, ADMET studies, behavioural test for cognition and motor function
c) **Techniques in Immunology:** Antibody Generation, Basis of vaccines and its generation in small animals, techniques to study innate cell mediated humoral immune response (concern research area with case study); Use of RNAi/FACS in Immunology

Module viii. Essential Paradigm in Medicinal Chemistry Research

1. Basic principles of Medicinal chemistry –Biochemical reactions relating to organic reactions, endogenous ligand and their role in drug design, serendipity in new drug discovery.
2. Concepts in drug targeting: Pathology of diseases e.g. PD, Alzheimer and Cancer, molecular pathways for identification of target for drug design,
3. Strategies for lead discovery-Lead identification and modification: Hammett equation, Hansch postulates and extension of Hansch equation, SAR and QSAR,
4. **Ligand based drug discovery:** Conventional methods and High Through put screening of the virtual libraries. Structure based drug design-*Classical methods and In-silico tools*
5. Pharmacophore and the Factors modulating the pharmacophore
6. Theories of drug and receptor (biomolecule) interactions
7. Factors influencing drug receptor interactions
8. Pharmacokinetics and drug metabolism and factors influencing drug metabolism

9. Modulation of drug like properties of compounds,
10. Measure the binding of agonist and antagonist with receptor and Enzyme kinetics to calculate substrate binding
11. Example of existing drug and their design strategies: drug acting on receptors and DNA

Paper PHBS-IV: Writing a Research proposal & Presentation

Research proposal writing	**50 marks**
Presentation and Viva-Voce	**50 marks**
Total Marks	**100 marks**

COURSES OFFERED FOR Ph.D. CURRICULUM

July 2023 onwards

Department of Biochemistry
Faculty of Interdisciplinary and Applied Sciences
University of Delhi South Campus
Benito Juarez Road New Delhi-110021

Passed in DRC held on 17th July 2023

The courses offered for the Ph.D. curriculum aim to provide the students with excellent knowledge in various Tools, Techniques and Research methodologies in Biochemistry emphasizing on solid background of basic concepts as well as rapid advancement in the field, providing them an initiation into their respective research fields. The department will offer the following two papers for Ph.D. course work:

Paper I (BIOCHEM P-I): RESEARCH METHODOLOGY
Paper II (BIOCHEM P-II): TOOLS AND TECHNIQUES IN BIOCHEMISTRY

These courses are also open for Ph.D. students from other departments in FIAS. The Ph.D. students of the biochemistry department are also free to choose from Ph.D. courses offered by the other departments. A student has to pass both the papers in one academic year (two semesters) to successfully complete the Ph.D. course work.

Evaluation: All the papers will have components of continuous evaluation and end semester examination. The total marks for each paper will be 100. A student has to score 50 marks to pass a paper. The distribution of marks will be as follows:

Paper	Continuous evaluation	End-semester evaluation	Total Marks
BIOCHEM P-I	50	50	100
BIOCHEM P-II	30	70	100

Both the courses will be offered in the July to December semester.

RESEARCH METHODOLOGY
(BIOCHEM P- I)

CREDITS- 4 **Total Hours: 64**

Unit 1. Biosafety and Bioethics in Research* No. of Hours: 8

Guidelines for Biosafety and Bioethics; Safety practices and Bio-waste in the laboratory; Radioactivity and safety; Fire hazards and safety; Institutional Biosafety, Ethics and Animal Ethics compliance and concerns; Genetically modified organisms; Patents and Intellectual property rights; Guidelines for Ph.D. thesis.

Unit 2. Defining the Research Problem No. of Hours: 34

Identification of broad area of research; Review of literature using appropriate sources – reviews, patents, research papers, books; Utilization of tools for literature source – web and libraries; Defining a research problem

Unit 3. Experimental Approaches and Methodology No. of Hours: 12

Experimental designs to address the research problem; Alternative plans for experimental design; Tools and techniques to execute experiments; Means to validate and analyze data; Methods of record keeping.

Unit 4. The art of Presentation No. of Hours: 10

Development of writing skills – Plan of research, Research project, Research report, Research article and review, Term paper; Bibliography, referencing and footnotes; Creation of reference libraries; Plagiarism check; Development of Oral presentation skills – Planning, Preparation, Practice, Oration; Use of visual aids and software like MS Word, MS PowerPoint, MS Excel, EndNote.

Students are expected to undertake the following assignments, exercises and evaluations.

1. Identify the broad area of research in consultation with Ph.D. supervisor.
2. Review literature, collate information, identify scope of research, formulate a research plan and prepare and submit a term paper including references.
3. Present and defend their research plan orally.
4. Evaluation will be based on term paper and oral presentation.

*Students are also encouraged to attend 1-2 days workshops / seminars / lectures on IPR / Bioethics / Biosafety. This can count towards the hours assigned for the module.

SUGGESTED READINGS

1. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.
2. Research Methodology: A Step-by-Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education.

TOOLS AND TECHNIQUES IN BIOCHEMISTRY
(BIOCHEM II)

CREDITS- 4 **Total Hours: 64**

Unit 1. Genomics No. of Hours: 11

Global expression profiling; Whole genome analysis of mRNA and protein expression; Real time PCR to monitor changes in expression levels; Concept of microarrays and its applications for DNA, RNA and proteins.

Unit 2. Spectroscopy and Spectrometry No. of Hours: 11

General principles of spectroscopy and spectrometry, theory and applications of various spectroscopic techniques; Mass spectrometry and its biological applications.

Unit 3. Recombinant DNA Technology No. of Hours: 10

Use of Restriction and modification enzymes in cloning, Plasmid/Phagemid vector, Ligation, Transformation and Plasmid isolation, Design of primers; PCR: Standard PCR, Hot Start PCR, Allele-Specific PCR, Colony PCR, Nested PCR, Applications of PCR in research, Basic DNA sequencing methods. Sanger's chain termination method, and automated DNA sequencing, Introduction to next generation sequencing (NGS) methods including base calling, sequence alignment, and variant calling.

Unit 4. Growth, Maintenance and Genetic engineering of Mammalian cells No. of Hours: 11

Basic requirements for *in vitro* cell culture, live cell staining and counting. Synchronization of mammalian cells and cell cycle analysis. Various ways of overexpressing and silencing genes in mammalian cells; Generation of transient and stable lines. Use of radioisotopes in cell biology.

Unit 5. Concepts of vaccine development No. of hours- 10

Vaccine development history, Vaccine generations and types, Vaccines and immunological memory, adjuvants, mechanism and need of adjuvant, vaccine engineering, antigen and antigenicity, Immune epitope database (IEDB), epitope mapping, vaccine preparation and protein expressions, vaccine testing and clinical trials.

Unit 6. Purification and Characterization of proteins and Drug discovery No. of Hours: 11

Expression vectors; Expression, isolation and purification of heterologous proteins; Chromatography techniques for protein purification; Mapping of protein interactions: two hybrid, Protein fragment complementation, Concepts of drug discovery and development.

SUGGESTED READINGS

1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
2. Molecular Cloning: A laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.
3. Animal Cell Culture & Technology (2004) 1st ed., Butler, M., Tailor & Francis Publishers (UK), ISBN-1: 859960499.
4. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7thed, Keith Wilson and John Walker, Cambridge University Press India Pvt. Ltd., ISBN-13: 978-0-521-17874-7 / ISBN:10: 0-07-099487-0.
5. R. Burgess, M. P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA.
6. System vaccinology: The history, the translational challenge and the future (2022); Academic Press Inc; ISBN-10: 0323859410.
7. Vaccine Design: Methods and Protocols, Volume 3. Resources for Vaccine Development: 2412 (Methods in Molecular Biology); Springer-Verlag New York Inc.; 2nd ed. 2022 edition; ISBN-101071618946 :

UNIVERSITY OF DELHI
DOCTORATE OF PHILOSOPHY
(Ph.D)
&
MASTER OF PHILOSOPHY
(M.Phil)

(w.e.f. Academic Year 2017-18)
(Syllabus)

Ph.D. Coursework Syllabus as approved by Departmental Research Committee on 29th August, 2017 and Board of Research Studies on 31st August, 2017.

विभागाध्यक्ष वाणिज्य विभाग/Head Department of Commerce
दिल्ली स्कूल ऑफ इकोनोमिक्स/Delhi School of Economics
दिल्ली विश्वविद्यालय/University of Delhi
दिल्ली-110007/Delhi-110007

I. PREAMBLE

The Department of Commerce, Faculty of Commerce and Business, Delhi School of Economics formally set up as a separate entity in 1967, has imbibed the DSE tradition of exploring new frontiers of knowledge and innovation in academics. In its history spanning about five decades, it has redefined commerce education in the country. The Department has the legitimate claim and pride of being the premier institution in India for course curriculum development, teaching and researches in Commerce discipline. The rapid growth of the Department of Commerce is reflected in its expansion as well as novelty in its academic programmes.

Two research programmes (M.Phil & Ph.D) in Commerce are taught at Department of Commerce, Faculty of Commerce & Business, Delhi School of Economics, University of Delhi. There are two modes of admission in M.Phil/Ph.D program

- Through Entrance
- Direct Admissions without entrance test

AFFILIATION

The programme shall be governed by the Department of Commerce, Faculty of Commerce and Business, University of Delhi, Delhi – 110007

II: M.Phil/ Ph.D. Programme Structure

Programme Structure

The M.Phil./ Ph.D. Programme is divided into two parts as under. First Part will consist of one semester.

Part I	Semester 1
Part II	Thesis Work/ Dissertation

The schedule of papers prescribed for various semesters shall be as follows:

Part I: Semester I

Papers		Total Marks	Credits
Paper No.	**Title**		
MP101	Research Methodology	100	4
	Area specific basic paper	100	4
MP102A	Accounting		
MP102F	Finance		
MP102IB	International Business		
MP102M	Marketing		
MP102OB	Organizational Behaviour and Development		
MP103	Term Paper I	100	4
Total		300	12

In addition to above papers two courses of 2 credits each may be offered in each semester under contemporary issues by faculty members.

Note: In regard to the course work, if needed, in view of the topic of the research proposal the supervisor may recommend specific paper for specific courses offered by the department in other areas of specialization and which the candidate is required to study.

III. Scheme of Examinations

1. English shall be the medium of instruction and examination.
2. The coursework for M.Phil. and Ph.D. shall be common.

3. Examinations shall be conducted at the end Semester as per the schedule notified.

- **Coursework Exemption and Rules**

Research scholars already holding M.Phil Degree or equivalent M.Phil degree (equivalence to be determined by DRC) and admitted to the Ph.D. programme, or those who have already completed the coursework in M.Phil of University of Delhi and have been permitted to proceed to the Ph.D. programme, may be exempted from the Ph.D. Coursework. All other research scholars admitted to the Ph.D programme shall be required to complete the Ph.D coursework prescribed by the Department.

The research scholar shall not be allowed to take up any assignments outside the University during the coursework.

- **Pass Percentage & Promotion Criteria**

1. All M.Phil/ Ph.D. scholars has to obtain a minimum of 55% of marks or its equivalent garde in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale) in the coursework in order to be eligible to continue in the programme and submit the dissertation/ thesis.
2. All research scholars admitted to M.Phil. / Ph.D. Programme shall be required to complete the coursework within initial one or two semesters.

- **Attendance Requirements**

Research scholars shall be required to attend lectures (coursework) and participate in seminars arranged in the Department during the programme. The minimum percentage of lectures to be attended during the coursework will be two-thirds of the lectures delivered in all courses, individually.

M. Phil/ Ph. D. Course Work
Paper MP101: Research Methodology

Credits: 4 **Teaching hours: 48**

Course Objective: *The course aims to equip the researcher with the tools and techniques as applied to business research.*

Contents:

Unit 1

Nature of management and business research: Applied vs. theoretical perspectives; Theory and research: The Relationship; Theory: Its meaning, types and elements, Literature review: Its *locus standi* as a theory; Inductive and deductive approaches to theory building.

Philosophical orientations to conducting research: Ontology and epistemology of research; Alternate epistemological and ontological perspectives and their relevance to research.

Introducing qualitative methods of Research: Grounded Theory, Phenomenology, Ethnography etc.

Unit II

Conducting research: The scientific research process; Formulation of Research Problem; Construct conceptualisation and operationalisation: Construct dimensionality and hierarchical structure.

Determining research design: Exploratory, descriptive and conclusive; Data sources: Secondary and primary data; Secondary data sources and their screening.

Unit III

Primary data collection methods; Designing the survey instrument: Questionnaire preparation. Measurement and scaling techniques.

Unit IV

Sample design: Sampling methods and techniques, sample size determination.

Field work and data collection, Sampling and non-sampling errors, Data screening and editing.

Unit V

Construct reliability and validity testing: Reliability - Its meaning and nature; Reliability testing approaches and methods; Validity - Its meaning and testing.

Preliminary data analysis, Descriptive and Inferential statistics - Major parametric and non-parametric tests; Analysis of variance, Correlation and regression analyses.

Unit VI

Introduction to multivariate analysis: Econometric analysis: Panel data, Time series analysis. Exploratory Factor Analysis, Discriminant Analysis.

Suggested readings: To be suggested by the concerned faculty at the time of teaching of the course keeping in view the relevance, contemporariness and research trends.

M. Phil / Ph. D. Course Work
Paper MP 102A: Accounting

Credits: 4 **Teaching hours: 48**

Course Objective: *To impart focused and relevant knowledge about the current developments in accounting*

Contents:

Unit I

Accounting Standards and Guidance: Notes on various accounting aspects issued and Standard setting process--- Accounting Principles, GAAP Development and Study of Accounting Standards. Study of Indian Accounting Standards and International Accounting Standards issued

Unit II

Comparative study of basic concepts of international accounting standards, US GAAP and standards in India

Unit III

IFRS Implementation and Challenges in India, Adoption of IFRS Worldwide and In India, Transition To IFRS

Unit IV

Corporate financial reporting - issues and problems with special reference to published financial statements. Financial reporting in respect of various kinds of financial institutions like mutual funds, non-banking finance companies, merchant bankers, stock brokers

Unit V

Development in Accounting : Interim reporting, Segment reporting, Corporate social reporting, Human resource accounting, Accounting for Intangible Assets , Accounting for Financial Instruments, Environmental accounting , Inflation Accounting, Accounting for Price Level change

Unit VI

STUDY OF EMERGING AREAS: Shareholders Value creation, Balanced Score Card, Contemporary issues in mergers and acquisitions, Derivatives and option Pricing Theory , Forensic Accounting-What Is Forensic Accounting? Economic Crime Investigations, Need Of Forensic Accounting, Fraud Deterrence Internal/External Audit

Suggested Readings: Readings for the course to be suggested by the concerned Faculty Keeping in view the relevance contemporariness and research trends.

M. Phil / Ph. D. Course Work
Paper MP 102F: Finance

Credits: 4 **Teaching hours: 48**

Course Objective: *To acquaint the students with the empirical evidence on various issues in finance, to prepare the students apply various concepts and theories in finance and equip them to identify research gaps and develop a framework for research in finance. The emphasis must be on reading and understanding of seminal as well as applied research papers which have provided empirical evidence on various issues and puzzles in finance.*

Contents:

Unit I- Corporate Finance:

Capital Budgeting Decision, practice and empirical evidence. Corporate Financing Decision, practice and empirical evidence regarding pecking order, signalling, asymmetric information, effect of taxes and emerging theories of capital structure. Dividend Decision- theories, policies, practice and empirical evidence regarding Signalling hypothesis, effect of asymmetric information etc., Factors affecting capital structure choice (Micro factors like Size, Profitability, Liquidity, Tangibility, Corporate Governance etc. and Macro factors like Tax rates, Economic policies, Capital market conditions etc.), Working Capital Management, Mergers & Acquisitions and other forms of corporate restructuring- research issues and empirical evidence.

Unit II- Financial System- Markets and Institutions: Financial system- Research issues and empirical evidence. Banking- Efficiency, regulation, crisis and empirical evidence. Securities Markets. Derivatives Market. Bond market- Research issues and empirical evidence.

Unit III- Investment Management I: Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis- empirical evidence and research issues. Asset pricing- Capital Asset Pricing Model and Non Standard forms of CAPM- testing methodologies and empirical evidence. Empirical evidence on various stock market anomalies (such as Size Effect, Value Effect, Prior Return Effect, Seasonality Effect etc.).

Unit IV- Investment Management II:

Multifactor Asset Pricing Models- Need and empirical evidence. Behavioural Finance- various behavioural biases (Such as Representativeness, Overconfidence, Mental Accounting etc.) Prospect theory, Issues in Behavioural Finance and empirical evidence.

Unit V- International Finance

Foreign Exchange Management- issues and empirical evidence. Exchange rate determination- factors and empirical evidence. Foreign exchange exposures- measurement and empirical evidence. International diversification- evidence on global portfolio management. International Capital Market.

Unit VI : Contemporary Issues in Finance:

Contemporary issues in all areas of finance such as – Financial crisis management, volatility spill over across financial markets, financial market integration, real options, socially responsible investing (SRI), ethical investing, financial modelling etc). Research papers dealing with contemporary issues should be discussed.

Suggested Readings: Readings for the course are primarily research papers and those suggested by the concerned faculty from time to time.

M. Phil / Ph. D. Course Work

Paper MP 102IB: International Business

Credits: 4 **Teaching hours: 48**

Course objective: *To develop an in-depth understanding of the theory of international business as well as strategy, structure and organisation aspects of firms engaged in international business.*

Contents:

Unit 1: Basics of International Business: Theoretical Foundations and operations

Globalisation and its drivers; Entry modes and development strategies; Evaluation of different modes and selection of an entry strategy

Unit 2: The Theory of Trade and Investment: Overview and recent developments

Trade theories – Mercantilism; The Theory of Absolute Advantage; The Theory of Comparative Advantage; Factor Proportions Theory; Product Life Cycle Theory; New Trade Theory; Theory of National Competitive Advantage

Investment Theories - Relationship between export and FDI; Internalization theory and market imperfections; Product Life cycle theory; OLI Theory and LLL theory;

Trade and investment policies

Unit 3: Economic Integration, Protectionism and WTO

Levels of Economic Integration – Free Trade Area; Customs Union; Common Market; Economic Union; Trade creation and trade diversion; Major Regional Trading Groups

Government intervention in Trade and Investment; World Trade Organisation (WTO); Important Agreements of WTO

Unit 4: Global Financial Environment

Foreign Exchange Market; International monetary system; Exchange rate arrangements; International money and capital markets; International banking

Unit 5: International Marketing

International marketing: An overview; EPRG framework and its relevance to assessment of a firm's involvement with international markets.

Internationalisation process of business firms: Theories and models; Psychic distance, international strategy formulation and firm performance; Consumer ethnocentrism and country-of-origin effects

Unit 6: International taxation and investment issues

International double taxation; International tax evasion and avoidance – Transfer pricing, Tax havens, treaty shopping; Methods to alleviate international double taxation; Double Taxation Avoidance Agreements (DTAAs); Bilateral Investment Treaties (BITs)

Suggested readings: To be suggested by the concerned faculty at the time of teaching of the course keeping in view the relevance and research trends.

M. Phil/ Ph. D. Course Work

Paper MP 102M: Marketing

Credits: 4 **Teaching hours: 48**

Course objective: *To enable scholars to gain insights into developments and issues related to researches in marketing.*

Contents:

Unit I: Nature and domain of marketing

Understanding marketing: A critical review of alternate definitions proposed by AMA; Domain of marketing: Hunt's three dichotomies model.

Marketing as a scientific discipline: Hunt's framework for examining arguments against and for marketing as a science.

Unit II Marketing Theory: Basics

Marketing theory, early schools of marketing thought and research streams.

Modern schools of marketing thoughts and research agenda.

Unit III: Advances in Marketing Theory

Service dominant (S-D) logic for marketing: Its nature, major premises and critical evaluation.

Resource advantage (R-A) theory of marketing: Its nature, major premises and critical evaluation.

Unit IV: Dynamics of Consumer Behaviour

Basics of consumer decision-making: Personal and interpersonal determinants of consumer behavior.

Consumer buying behavior: Theories and models.

Unit V: Developments and Emerging Issues in Marketing - I

Services marketing: Nature, issues and challenges; Service quality – Its conceptualization, operationalization and linkages with other variables.

Relationship marketing: Evolution, nature and scope; Conceptualisation and operationalization of relational variables and their linkages.

Unit VI: Developments and Emerging Issues in Marketing - II

Green marketing and consumer behavior.

Marketing ethics: Nature and role of ethics in marketing, Ethical decision making process.

Suggested readings: To be suggested by the concerned faculty at the time of teaching of the course keeping in view the relevance, contemporariness and research trends.

M. Phil / Ph. D. Course Work

Paper MP 102OB: Organizational Behavior and Development

Credits: 4 **Teaching hours: 48**

Course Objective: *This course is to involve students in an intensive analysis of organization and environment interface. The aim of interaction with the students is to encourage them to develop cross-boundary ideas and prepare a research proposal.*

Contents:

Unit I: Organization Systems and Structures

Organizations as social systems, the changing context of organization environment
Interface, organization as open system, design and structure of organization

Unit II: Leadership in Organizations

Role of leader in the organization, approaches to leadership, nurturing Leadership for future organizations; management of organizational pressures – Internal and External

Unit III: Power and Politics

Power and politics in the organization, concepts and bases of power, role of organizational politics in its functioning

Unit IV: Organizational Change

The dynamics of change in organizations, dealing with resistance to change, organizational interventions to manage change

Unit V: Organizational Culture

Organizational culture and climate, Impact of workforce demography on the organizations, organizational responses towards managing workplace diversity; cross-cultural difference in organizational practices: Asia, Africa, Middle East, North America, and Europe

Unit VI: Contemporary Research Issues in HR

Organizational Effectiveness, Person –organization fit, artificial intelligence in HR, generational studies in HR,
Above topics are indicative and other contemporary issues –may be discussed.

Suggested readings: A list of readings may be prepared by the discussant faculty keeping research processes, courseware, path breaking and contemporary works in mind.

Research Methodology

Ph.D. in Education

This is a second level course in Research Methodology and expects and builds on a basic understanding of educational research and research methods relevant to research in social sciences in general, and educational research in particular. A Ph.D. scholar who has not had prior engagement with the first level course is advised to read the basic texts recommended below and equip himself/herself for the course at this level.

Basic readings:

Bell, J. (2010). *Doing Your Research Project: A Guide for First-Time Researchers in Education and Social Science*. (5th Ed.) The Open University Press. (Available online)

Creswell, J.W. (2007). *Qualitative Inquiry and Research Design: Choosing among Research Traditions,* New Delhi: Sage Publications.

It is important to develop a deep understanding of the nature of educational research as often educators seek remedies of educational problems without understanding the nature of the issues and problems. Hence, quality research which contributes to knowledge building about various facets of education in India is crucial. This course will help in understanding not only the procedures of research but also issues related to its conceptualization and theory. It will critically examine the processes and contextualize it within the current discourse of educational research.

The objectives of the course are as follows:

- Developing understanding about research processes by engaging with fieldwork and examining existing research studies.
- Learning to critically analyse not only the research process and papers but also one's own experiences as a researcher.

Unit 1: Foundations of Educational Research: Historical background relating to the philosophies impacting educational research and current situation. Role of theoretical perspectives on conceptualizing research and knowledge construction.

Unit 2: Research Processes and Perspectives:

- Quantitative and qualitative perspectives
- Special focus on survey, qualitative methods, and case studies. Comparing and contrasting to gain understanding of these methods and their strengths and limitations. Issues related to sampling, access, generalization, and subjectivity will be discussed.
- Examining the tools of research with a focus on preparing questionnaire/interviews, and observation. Contrasting differences of approaches in the use of these tools, for example, contrasting structured and unstructured interviews, or participant observation with other kinds of observation.
- Ensuring data quality: Examining ways of ensuring data quality depending on the type and purposes of research approach being used. Topics will include validity, reliability, triangulation, discussions on subjectivity and representativeness.
- Analysis of data and drawing conclusions
- Ethics of research.

Unit 3: Some Relevant Topics/issues specific to Educational Research:

- Classroom-based research
- Research with children: Challenges and concerns.
- Examining concept development and pedagogy of various subject areas including Maths, language, social studies, and science

Note: There will be specific sessions on the following topics/areas that will help the researcher to get a hands on experience of handling different facets of research:

Literature Review/data search, bibliography and citation, using soft-ware for data analysis (for example, SPSS and NVIVO), presentations skills and writing skills. The scholar is required to make class presentations and submit written assignments regularly. Assessment will be done on the basis of small and big assignments and a take-home or sit-in open book exam at the end of the course.

Readings:

Atkinson, P. et al. (Eds.) (2001). *Handbook of Ethnography.* London: Sage Publications.

Bryman, A. & Burgess, R.G. (Eds.) (1999). *Qualitative Research*, Volumes I, II, III and IV. London: Sage Publications. Selected chapters for different aspects.

Burgess, R.G. (Ed.) (1984). *The Research Process in Educational Settings: Ten Case Studies,* Philadelphia: The Falmer Press. (Read the Introduction, conclusion and any one chapter for writing a critique-see Task 1.)

Corbin, J. & Strauss, A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (3rd ed.), Los Angeles: Sage Publications.

Denzin , N.K. & Lincoln, Y.S. (Eds.) (2000). *Handbook of Qualitative Research* (2nd Ed.), Thousand Oaks: Sage Publications.

Denzin, N.K. & Lincoln, Y.S. (Eds). (2003). *Strategies of Qualitative Inquiry.* (2nd Ed.), Thousand Oaks, California: Sage Publications Inc.

Eisner, E.W. (1998). *The Enlightened Eye: Qualitative Inquiry and the Enhancement of Educational Practice.* New Jersey: Prentice Hall, Inc. Introduction and Chapters 1, 2, 3 8, 9, 10 and 11.

Geertz, C. (1993). *The Interpretation of Cultures: Selected Essays*. London: Fontana Press. Chapter 1

Green, J.L., Camilli, G. & Elmore, P. B. (Eds.). (2006). *Handbook of Complementary Methods in Education Research.* Mahwah,NJ: Lawrence Erlbaum Associates Inc.

Holliday, A. (2007). *Doing and Writing Qualitative Research* (2nd ed.), London: Sage Publications. An Excellent book for beginners: a must read for all of you!!

Srivastava, V.K. (Ed.) (2004). *Methodology and Fieldwork*, New Delhi: Oxford University Press.