VIVEK UNIVERSITY

[Estd. by Govt. of Uttar Pradesh, as per Uttar Pradesh Private Universities Act, 2019, no.21 of 2024.]

MORADABAD ROAD, POST AGRI, BIJNOR, UTTAR PRADESH-246701, INDIA

Syllabus

Pre-Ph.D. Course Work

Computer Application & Information

Technology

Effective from Academic Session (2024-2025)

Course Structure and the Assessment Scheme of

Pre Ph.D. Course Work Syllabus

SN	Paper Code	Subject	Credits L:T:P	Total credit	Total marks (External + Internal)	Minimum marks to be scored for successful completion
1		Research Methodology (Common for All)	3:1:0	4	60+40	50
2		Research & Publication Ethics (Common for All)	1:1:0	2	30+20	25
3		Quantitative Methods and Computer Applications (Common for All)	3:1:0	4	60+40	50
4		Advances in Computer Science	3:1:0	4	60+40	50
5		Field work (Seminar/ workshop/ conferences/ literature review)	0:0:4	4	(0+100)	50
		Total		18	450	225

Note: 1. A Ph.D. scholar must attain a minimum of 55% marks in aggregate.

2. Internal marks shall be based on assignments/class activity/case study and other academic activities provided by course instructor.

Programme objectives:
1. Equip themselves with ethical issues related to Research and Publication.
2. Offer expertise, resources, and services to the community in the field of Computer Science & Applications.
3. Proficiency with fundamental knowledge in several specialized areas of research and expertise in at least one area of research related to latest technologies in Computer Science & Applications.
4. To contribute the advancement of knowledge and technology to enhance activities in Computer Science & Applications.
5. Organize and conduct research (advanced project) in a more appropriate manner.

Programme Outcomes:
1. Provide students with knowledge, general competence, and analytical skills in Research Methodology, Research & Publication Ethics and Computer Science & Applications.
2. Build their foundation for research in Computer Science & Applications.

3. Provide hands-on experience to carry out research work in Computer Science & Applications as well as interdisciplinary areas.
4. Knowledge and understanding of ethical standards in proposing, executing, and communicating scientific research.
5. Ability to communicate concepts and results to a technical audience in the form of conference papers, journal papers, and/or oral presentations etc.

Programme Specific Outcomes:

1. Apply appropriate research methodology, tools & techniques for systematic investigation, data analysis and solving the problems.
2. Gain ability to apply knowledge of latest technologies in Computer Science & Applications to research in real-world issues.
3. Get familiar with current research trends in various core areas of Computer Science & Applications.
4. Leadership and self-reliance Impact leadership abilities to the students to lead and excel in their respective fields. Also, the training will make students self-reliant.

Paper-I: Research Methodology (Common)

Course objectives:
1. To understand some basic concepts of research and its methodologies & identify appropriate research topics.
2. Select and define appropriate research problem and parameters.

Course outcomes:

1. To familiarize the research scholar with the fundamentals of scientific research.
2. To develop understanding of the basic framework of research process.
3. To develop an understanding of various research designs and techniques.
4. To identify various sources of information for existing research and data collection.
5. To develop an understanding of the ethical dimensions of conducting applied research.
6. Apply the theoretical and experimental knowledge into research work.

Unit-I
- **Scientific Research:** Meaning, importance and characteristics of scientific research, validity in research, Selection and formulation of Research Problem, Research Design, Phases/stages in research; types of research- qualitative, quantitative, exponential, exploratory, empirical, descriptive, ex-post facto, case studies, historical studies, philosophical studies, quasi-experimental; ethical problems in research; constructs and variables- nature of construct and variables, concept of constructs, type of variables, continuous and categorical, constructs, observables and intervening variables; Review of literature- purpose of the review, sources of the review, preparation of index card for reviewing and abstracting.

Unit-II

- **Methods of Research**: General Survey of various methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

Unit-III

- **Problem Identification and Hypothesis Formation:** Problem- meaning and characteristics of a problem, types of problem, generality and specific of problem; hypothesis- meaning and characteristics of a good hypothesis, types of hypotheses, formulating a hypothesis, ways of stating a hypothesis; testing experimental hypothesis- standard error, test of significance, level of significance, degrees of freedom, errors in hypothesis- type I, type II errors.

Unit-IV

- **Sampling and Research Design:** Meaning and types of sampling; probability and non-probability sampling. Methods of drawing samples, requisites of a good sampling method, sample size, sampling error; meaning and purpose of research design, types of

research design, criteria of a good research design, basic principles of experimental design.

Unit-V

- **Report Writing:** Meaning and significance of report writing, types of report, steps in writing report, layout of the research report, precaution in writing research report, developing thesis report, formatting, inside citations, references and bibliography. Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report

Suggested Reading:

- Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
- Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.
- Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
- Goodde and Hatte (1952) Methods in Social Research, New York, McGraw – Hill.
- Cooper & Schindler, Business Research Methods, Tata McGraw Hill.
- Broota, K.D., Experimental Designs in Behavioural Research, New Age International.
- Singh A. K., Test Measurement and Research Methods in Behaviours Sciences, Bharti Bhawan.

Paper-II: Research & Publication Ethics (Common)

Course objectives:
1. To understand the philosophy of science and ethics, research integrity and publication ethics research misconduct.
2. To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.), predatory and clone Journals.

Course outcomes:

1. To develop an understanding of research ethics, publications misconduct and plagiarism.
2. To develop Intellectual honesty and research integrity as per committee of publication ethics.
3. To identify various sources of information for data bases and research matrices.
4. To develop an understanding of Open access publications and initiatives.
5. To understand the usage of similarity index tools.
6. Appreciate the components of scholarly writing and evaluate its quality

I. Philosophy and Ethics: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition moral philosophy, nature of moral judgements and reactions.

II. Scientific Conduct: Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification and Plagiarism (FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

III. Publication Ethics: Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals Practice.

IV. Open Access Publishing: Open access publications and initiatives, SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

V. Publication Misconduct: Group Discussion, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. Software tools, Use of plagiarism software like Turnitin, Drillbit, iThenticate and other open-source software tools.

VI. Databases and Research Metrics: Databases, Indexing databases, Citation databases: Web of Science, scopus, etc., Research Metrics, Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score, Metrics: h-index, g index, i10 index, altmetrics.

Paper-III: Quantitative Methods and Computer Applications (Common)

Course objectives:
1. To gain familiarity about various data collection tools and techniques, data analysis and interpretation along with the application of computer and statistical software in research.
2. Application of various statistical and computer software's in research and development.

Course outcomes:

1. Analyse qualitative and quantitative data, and explain how evidence gathered supports or refutes an initial hypothesis.
2. Describe descriptive and inferential statistics techniques.
3. To apply the statistical techniques and computer software's for data analysing.
4. Develop research skills of administering research tools and data collection.
5. Able to locate the research studies available in the Internet and use of online journals and books,
6. Use computer techniques and software's for research & data analysing.

Unit-I

- **Measurement and Scaling Techniques:** Measurement in research, measurement scales sources of errors in measurement, tests of second measurement, techniques of developing measurement tools, meaning of scaling, scale classification bases, important scaling techniques, and scale construction techniques.

Unit-II

- **Data Collection, Processing and Analysis:** Methods of data collection – primary data, secondary data; primary data collection – observation method, interview method, questionnaires, schedules, guideline for constructing questionnaires/schedules, secondary data collection of, selection of appropriate method of data collection; coding, editing and tabulation of data, charts and diagrams used in data analysis, bar and pie diagrams and their significance; measures of central tendency, measures of dispersion; correlation and regression analysis - meaning and uses, methods of calculation of coefficients and their analysis and implication. sampling distribution, sampling schemes and sample sizes, confidence interval for the mean, t-statistic, z-statistic, confidence interval for the population variances, hypothesis testing, test of hypothesis for the population mean, population variance and ratio of two population variances; applications of z-test, t-test, f-test and chi-square test, association of attributes and techniques of testing, ANOVA.

Unit-III

- Fundamental knowledge of computer, statistical software and their application, application of statistical tests/techniques through the use of statistical software like SPSS, scientific packages like LISREL, AMOS, and SYSTAT for documentation and report generation.

Unit-IV

- **Introduction to MS-Office:** MS-WORD, MS-EXCEL, MATLAB, LATEX, MINITAB, R- programming. Applications of AI & ML in research.

Suggested Reading:

- Power Analysis for Experimental Research: A Practical Guide for the Biological, Medical and Social Sciences by R. Barker Baushell, Yu-Fang Li, Cambridge University Press.

- Chandan J. S., Statistics for Business and Economics, Vikas Publications.

- Broota, K.D., Experimental Designs in Behavioral Research, New Age International.

- Singh A. K., Test Measurement and Research Methods in Behavioral Sciences, Bharti Bhawan.

- Joyce Cox & Polly Urban, Microsoft Office, Galgotia Publishing.

- Sinha P.K., Computer Fundamentals, BPB Publishing.

- LaTeX: A Document Preparation System, 2/E Pearson Low Price Edition by Lamport.

- MATLAB: An Introduction with Applications by Gilat, Wiley India Pvt. Ltd.

- Getting Started with MATLAB by Rudra Pratap, Oxford University Press.

Course Objectives:

1. Provide in-depth knowledge of current trends and advancements in areas like artificial intelligence, machine learning, data science, quantum computing, blockchain, cybersecurity, and more. To implementing deep learning models and advanced ML approaches for real-world problems.
2. Emphasize research that leads to practical applications, innovations, and solutions to real-world problems.

Course Outcomes:

1. To develop better understanding advanced ML algorithms and techniques.
2. Implementation of deep learning models and advanced ML approaches for real-world problems.
3. Implementation of NLP models to real-world text-based applications.
4. Implementation of advanced cryptographic techniques to secure communication and data.
5. To gain an in-depth understanding of blockchain technology and how to secure decentralized systems.
6. Implementation of big data processing technologies to handle large-scale data.

Unit-I

- **Artificial Intelligence (AI) & Machine Learning (ML)** Supervised and unsupervised learning**,** Deep learning (Convolutional Neural Networks, Recurrent Neural Networks)**,** Generative models (GANs, VAEs)**,** Reinforcement Learning**,** Transfer Learning, Meta-Learning**,** Active Learning**,** Neural Architecture Search**,** Hyperparameter optimization

Unit-II

- **Natural Language Processing (NLP):** Text representation techniques (TF-IDF, word embedding, transformers), Sequence-to-sequence models (RNNs, LSTMs, GRUs), Attention mechanisms and BERT, GPT Language modeling and sentiment analysis, Information retrieval, question answering, Named Entity Recognition (NER)
- **AI in Robotics:** Autonomous systems and control, Robot perception (vision, audio processing), SLAM (Simultaneous Localization and Mapping), Multi-agent systems

Unit-III

- **Cybersecurity and Cryptography** Public Key Cryptography and RSA**,** Elliptic Curve Cryptography (ECC)**,** Zero-Knowledge Proofs**,** Cryptographic protocols and standards (SSL/TLS, AES)**,** Post-quantum cryptography**,** Secure multi-party computation
- **Network Security and Protocols:** Network vulnerabilities (DDoS, Man-in-the-Middle), Firewalls, VPNs, IDS/IPS systems, Secure communication protocols (IPsec, SSH), Authentication and access control protocols, Intrusion detection and prevention systems (IDS/IPS)

Unit-IV

- **Blockchain and Decentralized Systems:** Blockchain architectures (Bitcoin, Ethereum), Consensus algorithms (Proof of Work, Proof of Stake), Smart contracts and

decentralized applications (dApps), Cryptographic primitives in blockchain, Blockchain security and scalability

Unit-V

- **Data Science and Big Data** Association rule mining, frequent item sets**,** Clustering techniques (K-means, DBSCAN)**,** Classification algorithms (SVM, Random Forest, XGBoost)**,** Anomaly detection and outlier analysis**,** Big data mining techniques
- **Big Data Technologies:** Hadoop ecosystem (MapReduce, HDFS), Apache Spark (RDDs, DataFrames), Stream processing (Apache Kafka, Apache Flink), NoSQL Databases (MongoDB, Cassandra), Cloud-based big data platforms (AWS, Azure)

Unit-VI

- **Deep Learning for Data Science:** Advanced neural networks (Autoencoders, GANs), Time-series analysis using deep learning, Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Transfer learning for image and text data

Unit-VII

- **Distributed Systems and Cloud Computing** Cloud deployment models (IaaS, PaaS, SaaS)**,** Virtualization and containerization (Docker, Kubernetes)**,** Cloud storage and databases (AWS S3, Google Cloud Storage)**,** Auto-scaling, load balancing, and fault tolerance**,** Cloud-based micro services architecture
- **Distributed Algorithms:** Consensus algorithms (Paxos, Raft), Distributed coordination (ZooKeeper, etcd), Fault-tolerant distributed computing, CAP theorem and consistency models

Suggested Reading:

1. **"Pattern Recognition and Machine Learning"** by Christopher M. Bishop.
2. **"Cryptography and Network Security"** by William Stallings.
3. **"Mining of Massive Datasets. v2.1"** by Jure Leskovek, Anand Rajaraman and Jeffrey Ullman.
4. **"Mastering Blockchain – Fourth Edition"** by Imran Bashir.
5. **"Advanced Deep Learning with Python"** by Ivan Vasilev.
6. **"Cloud and Distributed Computing: Algorithms and Systems"** by Rajiv Misra and Yashwant Singh Patel.