CENTRAL UNIVERSITY OF HARYANA

(*Established under the Central Universities Act, 2009*)

(NAAC Accredited 'A' Grade)

CBCS Based
Curriculum and Syllabi
of
Ph.D. (Computer Science) Course Work

(w.e.f. July, 2022)

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

SCHOOL OF BASIC SCIENCES

CENTRAL UNIVERSITY OF HARYANA

SCHOOL OF BASIC SCIENCES

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Course Structure and curriculum for course work for Ph.D. (Computer Science) degree

Sr. No	Course No	Course Name	Course Code	Course Type	Credit
1.	CSP-01	Research Methodology	SBS CS 020101 C 5016	Core	6
Compulsory course as per UGC guidelines (Offered by Central Library)					
2.	CSP-02	Research and Publication Ethics	CPE-RPE	Core	2
Any one course from					
3.	CSP-03	Internet of Things(IOT)	SBS CS 020101 E 5016	Elective	6
4.	CSP-04	Data Warehouse and Mining	SBS CS 020102 E 5016	Elective	6
5.	CSP-05	Data Science	SBS CS 020103 E 5016	Elective	6
				Total credit=	**14**

Eligibility: PG Degree in computer science / computer science and application / information technology / computer science and engineering OR specialization in computer / information technology domain.

** Selection criteria, eligibility, examination, reservation policy, etc. as per UGC guidelines / CU Haryana PhD ordinance.*

Central University of Haryana
Department of Computer Science and Information Technology

Course Type	**:**	**Core**
Course Name	**:**	**Research Methodology**
Course Code	**:**	**SBS CS 020101 C5016**
Contact Hrs. per week	:	6
Credit	**:**	6

Course Objective and Learning Outcomes:

The guiding philosophy of knowledge creation and dissemination will be discussed in this course. The idea about various approaches to research, data collection, analysis, and inference will be taught. Principles of formulating research problems, designing experiments, and documentation will form a major part of the course. Specific objectives and techniques of chemical sciences research will also be presented. At the end of the course the students are expected to identify, design, and plan research problems, prepare research proposals and contemplate publications and reports when presented with data.

UNIT I: METHODS AND TYPES OF RESEARCH

Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research proposals-design and components.

UNIT II: LITERATURE REVIEW

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas fromliterature review - Development of working hypothesis.

UNIT-III: SCIENTIFIC SOFTWARE IN RESEARCH DESIGN AND METHODS AS APPLIED

Data Analysis using Tools like MS Excel, Tableau and SQL, etc.

Digital Methods and Web Search: Internal basics, Internet protocols, pre-requisites, search engines – Scopus, Google scholar, Scifinder, research gate; using

advanced search techniques, web resources, e-journals, e-books, journal access, subscribingTOC alerts, hot articles, citation index – h-index and i-index; Impact factor.

UNIT-V: REPORTING, DOCUMENTATION, AND PRESENTATION

Scientific Document: Organization and writing of research papers, short communications, review articles, monographs, technical and survey reports, authored books, and edited books and

dissertations.

Writing of Thesis: Format of a thesis: Review of literature, formulation, writing methods, results, preparation of tables, figures, writing discussion, summary and conclusion, synopsis, references citing and listing, bibliography, acknowledgment, avoiding plagiarism, Oral presentations-visual aids.

Suggested Readings

1. A. Fink, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
2. M. Graziano, A.M. Anthony and M. L. Raulin, Research Methods: A Process of Inquiry, Allyn and Bacon., 2009.
3. W. M. K. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing, 2005.
4. P. D. Leedy and J. E. Ormrod, Practical Research: Planning and Design, Prentice Hall, 2004.
5. B. L. Garg, R. Karadia, F. Agarwal and U. K. Agarwal, An introduction to Research Methodology, RBSA Publishers, 2002.
6. R. A. Day, How to Write and Publish a Scientific Paper, Cambridge University Press, 1992.
7. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, 1990.
8. S. M. Coley and C. A. Scheinberg, Proposal Writing, Sage Publications, 1990.

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Course Type	**:**	**Core**
Course Name	**:**	**Research and Publication Ethics**
Course Code	**:**	**CPE-RPE**
Credits	**:**	**2**

Theory

RPE 01: Philosophy and Ethics (3 hrs.)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgment, and reactions

RPE 02: Scientific Conduct (5 hrs.)

1. Ethics with respect to science and research
2. Intellectual honesty and research 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

RPE 03: Publication Ethics (7 hrs.)

1. Publication ethics: definition, introduction, and importance
2. Best practices / standards-setting initiatives and guidance: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship, and contributorship
6. Identification of publication misconduct, complaints, and appeals
7. Predatory publishers and journals

Practice

RPE 04: 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.

RPE 05: Publication Misconduct (4 hrs.)

A. Group Discussion (2 hrs.)

1. Subject-specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

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

RPE 06: Databases and Research Metrics (7 hrs.)

A. Databases (4 hrs,)

1. Indexing databases Research Metrics
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of the journal as per Journal Citation Report, SNIP, SJR, IIP, Cite Score
2. Metrics: h index, g index, i10 index, metrics

Suggested Readings:

1. Bird, A. (2006). *Philosophy of Science*. Routledge
2. MacIntyre, Alasdair (1967) *A Short History of Ethics*. London
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research and why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.neihs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489 (7415),179-179. https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1-7.
8. Vishal Goyal, G S Batra "Research and Publication Ethics" DPS Publication House.

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Course Type	**:**	**Elective**
Course Title	**:**	**Internet of Things (IoT)**
Course Code	**:**	**SBS CS 020101 E 5016**
Contact Hrs. per week	**:**	**6**
Credit	**:**	**6**

Course Objective and Learning Outcomes:
Students will understand the concepts of Internet of Things and can able to build IoT applications. Understand the concepts of Internet of Things, analyze basic protocols in wireless sensor networks, Design IoT applications in different domains and be able to analyze their performance.

UNIT I
Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT II
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT. M2M vs IoT

UNIT III
An Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, and standards considerations. Reference Architecture and Reference Model of IoT

UNIT IV
IoT Reference Architecture- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational, and Deployment. Constraints affecting design in IoT world-Introduction, Technical design Constraints.

UNIT V
Domain-specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT application.
Developing IoT solutions: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Suggested Readings

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1E, VPT
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications
4. CunoPfister, Getting Started with the Internet of Things, O"Reilly

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Course Type	**:**	**Elective**
Course Title	**:**	**Data Warehouse and Mining**
Course Code	**:**	**SBS CS 020102 E5016**
Contact Hrs. per week	:	6
Credit	**:**	**6**

Course Objective and Learning Outcomes:
This course gives an introduction to methods and theory for the development of data warehouses and data analysis using data mining. Data quality and methods and techniques for preprocessing of data. Modeling and design of data warehouses. Algorithms for classification, clustering, and association rule analysis. Practical use of software for data analysis.

UNIT I
Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing; the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization, and Concept Hierarchy Generation.

UNIT II
Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Different types of Cubes and Data Generalization: Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

UNIT III
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining. Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods

UNIT IV

Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, GridBased Methods, Model-Based Clustering Methods.

UNIT V

Introduction to different applications of Data Mining: Time Series and Sequence Data Mining, Graph Mining, Social Network Analysis, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web. Additional Themes on Data Mining and Social Impacts of Data Mining.

Suggested Reading:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, 2nd Edition, 2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.
3. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.
4. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition
5 Data Mining Introductory and advanced topics –Margaret H Dunham, Pearson education
6. Data Mining Techniques – Arun K Pujari, University Press.

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Course Type	**:**	**Elective**
Course Title	**:**	**Data Science**
Course Code	**:**	**SBS CS 020103 E 5016**
Contact Hrs per week	**:**	**6**
Credit	**:**	**6**

Course Objective and Learning Outcomes:

It offers students to learn, understand, and practice big data analytics and machine learning approaches, which include the study of modern computing Big data technologies. Scaling up machine learning techniques focusing on industry applications. Conceptualization and summarization of big data and machine learning, trivial data versus big data, big data computing technologies, machine learning techniques, and scaling up machine learning approaches.

UNIT I

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT II

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

UNIT III

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties, and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT IV

Data visualization: Introduction, Types of data visualization, Data for visualization, Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT V

Applications of Data Science, Technologies for visualization, Recent trends in various data collection and analysis techniques, various visualization techniques, and application development methods used in data science.

Suggested Reading:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.