Karnataka State Open University

Mukthagangotri, Mysore-570006

DOCTOR OF PHILOSOPHY (Ph.D.) IN COMPUTER SCIENCE

Ph.D. Course Work Syllabus

(Academic Year 2024-25 and onwards)

I Preamble

The Karnataka State Open University (KSOU) has taken an initiative step to start a Master's Program i.e. M.Sc. in Computer Science to meet the demand in 2010-11 and MCA/BCA/BSc-CS program in 2022-23. After interacting with experts in the domain, and after a thorough discussion among the experts in the form of a workshop, the Board of Studies in Computer Science of KSOU has prepared a good curriculum content to maintain the quality of M.Sc. / MCA/BCA/B.Sc.-CS in Computer Science program on par with that of other universities. With this background, the Department of Studies and Research in Computer Science considers it to be its privilege to initiate the PhD program by welcoming you all. I feel that it is also your privilege to be the student of our department.

Ph.D. programme in computer science is governed by KSOU Ph.D. Ordinance – 2012(IV Amendment 2023) Ph.D. in the department is conducted in a regular mode strictly as per the UGC Ph.D. Regulation 2016. The eligibility condition, exemptions details of CET, coursework, registration for pursuing Ph.D. submission of periodical report, research advisory committee and its role, evaluation etc., have been explicitly provided in the Ph.D. Ordinance – 2012(IV Amendment 2023)

II Ph.D. Programme Structure

The Ph.D. Coursework structure consists of three papers viz, Ph.D. Ordinance – 2012 (IV Amendment 2023)

01. Research Methodology
02. Cognate Subject
03. Area of Specialization
04. Research and Publication Ethics (RPE)
05. Viva-voce

Medium of instruction:

The medium of instruction shall be in English only

Karnataka State Open University
Department of Computer Science Course Work for Ph.D Programme
Course Structure and Scheme of Examination

Sl no	Course title	No. of credits	Total Learning Hours	IA	IA Min	Term End Exam	Term End Min	Total Min	Total marks
1	Research Methodology	03	45	25	10	75	40	50	100
2	Cognate subject	03	45	25	10	75	40	50	100
3	Area of specialization	03	45	25	10	75	40	50	100
4	Research and Publication Ethics (RPE)	02	30	10	5	40	20	25	50
5	Viva voce	01				50	20	20	50
	Total	**12**	**165 Hrs**	**85**		**315**	**160**	**195**	**400**

* Credit weightage: 1 credit = 15 hours of teaching

Note: All provisionally registered scholars shall attend the coursework classes at Department and Complete the Course work. (Sec 14.10)

III. Scheme of Examinations

01. English Shall be the medium of instruction and Examination.

02. Examination shall be conducted at the end of first Six months as per the notification.

03. Pass Percentage

i. A Candidate has to secure a minimum of 55% marks (Including the internal assessment) in both the courses for qualifying the course –work examination.

ii. In the course end examination the minimum for pass in each theory paper shall be 40% and 50% in aggregate including the continuous assessment marks.

iii. The candidates who are not qualified in the course work shall be allowed to take only one improvement examination within three months of their first examination. (Sec 16.3)

Course I

Compu.Sci. CW 1: RESEARCH METHODOLOGY

Total Hours: 45

Duration: 3hours Max. Marks: 100

COURSE OUTCOMES (COs)

After completing this paper, the students will be able to:

CO 1: **Identify and discuss the role and importance of research in the computer sciences.**

CO 2: Identify and discuss the issues and concepts salient to the research process.

CO 3: Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

CO 4: Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.

UNIT-I: **INTRODUCTION** **10hrs.**

Meaning, Objectives, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.

UNIT-II: RESEARCH DESIGN **10hrs**

Meaning, Need for Research Design, features of a Good Design, Important Concepts relating to Research Design, Different Research Designs. Cluster Analysis: Introduction, distance measures Clustering algorithms, agglomerative clustering. Scientific body in research: Ethical, legal, social and scientific issues in research. A brief idea about the funding agencies such as DST (Department of Science and Technology), DBT (Department of Biotechnology), ICMR (Indian Council of Medical Research), CSIR (Council of Scientific & Industrial Research) and UGC (University Grants Commission). Role of IPR (Intellectual Property Rights) in Research and Development.

UNIT-III: DATA COLLECTION **10 hrs.**

Introduction, Experiments and surveys, Collection of Primary and Secondary Data, selection of appropriate method for data collection, case study method. DATA PREPARATION: Data Preparation process, Some problems in preparation process, Missing values and Outliers, types of Analysis, Statistics in research.

UNIT-IV: TESTING OF HYPOTHESIS **10 hrs.**

Hypothesis, Basic Concepts Concerning Testing the Hypotheses, Test Statistic and Critical region, critical value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for – Means, Proportions, variance, difference of two mean, difference of two proportions, difference of two variances;P-Value approach, power of test, Limitations of the Tests of Hypotheses. ChiSquare Tests.

UNIT V: INTERPRETATION AND REPORT WRITING **05 hrs.**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Citation: MLA and APA, Publication, Impact factor: definition and calculation, H-index: introduction, calculation, g-index, Plagiarism: introduction, Ethics and morals, Copyright, Trademarks and Patents.

References

1. Research Methodology: A step-by-step guide for beginners,RanjitKumar,Sage publications.
2. Engineering Research Methodology A Practical Insight for Researchers by Dipankar Deb, RajeebDey, Valentina E. Balas.
3. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi).
4. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India).
5. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India).
6. MLA(Modern Language Association) Handbook for Writers of Research Papers, 7th edition, 2009.
7. How to Write and Publish a Scientific Paper, Cambridge University Press.
8. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
9. Citation Analysis in Research Evaluation (Information Science and Knowledge Management) by Henk F. Moed.

Course II

Compu. Sci. CW 2: Concrete Mathematics

Total Hours: 45

Duration: 3hours Max. Marks: 100

COURSE OUTCOMES (COs)

After completing this paper, the students will be able to:

CO 1: To read well-known and popular literature in Computer Science and Mathematics
CO 2: To develop mathematical skills, formulating and solving complex problems mathematically
CO 3: To practice with presentation of results (solutions of mathematical problems)
CO 4: To understand the application of mathematics in real life

UNIT-I **10Hr**

The Foundations: Logic and Proof, Sets and Functions: Logic, Proposition Equivalences, Predicates and Quantifiers, Nested Quantifiers, Methods of Proof, Sets, Sets Operations, Functions. Mathematical Reasoning, Induction, and Recursion: Proof Strategy, Sequences and Summations, Mathematical Induction, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Correctness

UNIT-II **15Hr**

Counting: The Basic of Counting, the Pigeonhole Principle, Permutation and Combinations, Binomial Coefficients, Generalized Permutation and Combinations, Generating Permutation and Combinations. Advanced Counting Techniques: Applications of Recurrence Relations, Solving Linear Recurrence, Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion, Applications of inclusion- Exclusion. Relations: Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence. Relations, Partial Orderings.

UNIT-III **5 Hr**

Discrete Probability: An Introduction to Discrete Probability, Probability Theory, Expected Value and Variance

UNIT-IV **10Hr**

Growth of Functions: Asymptotic notation, Standard notations and common functions. Summations: Summation formulas and properties, Bounding Summations. Recurrences: The substitution method, the iteration method, the master method, proof old the master theorem.

UNIT-V **5 Hr**

Sets: Sets, Relations, Functions, Graphs, and Trees. Counting and Probability: Counting, Probability, Discrete random variable, the geometric and binomial distributions, the tails of the binomial distribution, Probabilistic analysis.

Reference Books:

1. Discrete Mathematics and Its Applications. Kenneth H. Rosen, TMH 5" Ed 2003

2. Introduction to Algorithms Thomas H Cormen, Charlcs E Leiserson, Ronald L Rivest PHI S" Ed 2003

3. Discrete Mathematical Structure Bernard Kolinan, Robert C Busby, Sharon Ross, PHI S" Ed 2000 4.

"Intwoduction to the Design and Analysis of Algorithms" Ananyl.evitin, Publisher: Pearson (2008). 5.

"Computer Algorithms "Horowitz E, Sahani S., Rajasekharan S., Galgotia Publication 2001.

Course III

Compu.Sci CW 3.1: Digital Image Processing and pattern Classification

Total No. hours: **45 hrs**

Duration: 3hours Max. Marks: 100

COURSE OUTCOMES (COs)

After completing this paper, the students will be able to:

CO 1: Explain the fundamentals of digital image and its processing.

CO 2: Perform image enhancement techniques in spatial and frequency domain.

CO 3: Elucidate the mathematical modelling of image restoration and compression

CO 4: Apply the concept of image segmentation.

CO 5: Describe object detection and recognition techniques.

UNITI **10 Hrs**

Introduction: Definition, Origin, and Examples of Digital Image Processing, Fundamental "Steps in Digital Image Processing.

Digital Image Fundamentals: Basic concepts, Image digitization, Basic Relationships between pixels. Digital image Properties.

UNIT II **10Hrs**

Intensity Transformations and Spatial Filtering: Intensity transformations, contrast stretching histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters gradient and Laplacian.

Filtering in the Frequency Domain: Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency filtering.

UNIT III **10 Hrs.**

Image Restoration and Reconstruction: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

UNIT IV **10 Hrs.**

Image Segmentation: Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region based segmentation, Watershed algorithm, Use of motion in segmentation.

Representation and Description: Boundary following, Chain codes, Polygon Approximation Approaches, signatures, Boundary descriptors, Regional descriptors, Uses of principal components for description.

UNIT V **5 Hrs.**

Pattern Classification: Bayesian Decision Theory, Parameter Estimation, nonparametric techniques, Supervised and Unsupervised Learning.

Reference Books:

1. A Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education,3 Edition, 2008.
2. Milan Sonka, VaciayHlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision". Cengage learning: 4 edition (I January 2014)
3Anil K. Jain. "Fundamentals of Digilal Image Processing", Prentice-Hall of India Pvt.LId.. 1997.
4 Richard O. Duda, Peter E. Hart, DavidG. Stork. " Pattern Classification", John Wiley & sons, 2td Edition, 2008.
5. Earl Gose, Richard Johnsonbaugh, Steve Jost "Pattern Recognition and Image analysis", Prentice Hall PTR, 1996

Course III

Compu.Sci. CW 3.2: Information and Network Security IoT, Cloud Computing, Mobile Computing

Total No.hours : 45 hrs

Duration: 3hours Max. Marks: 100

COURSE OUTCOMES (COs)

CO 1: Analyze and evaluate the cyber security needs of an organization.

CO 2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

CO 3: Measure the performance and troubleshoot cyber security systems.

CO 4: Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.

CO 5: Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators

CO 6: Design and develop a security architecture for an organization. g) Design operational and strategic cyber security strategies and policies.

CO 7: To identify various popular research trends in networking and build the insights of the research areas such as IoT, Cloud Computing, Mobile Computing etc.

Unit – I : Basics of Information Security **5 Hrs**

NSTISSC(National Security Telecommunications and Information Systems Security Committee) security model, Components of an Information System, Securing components, Balancing Information Security and Access, Approaches to Information Security implementation; The Security System Development Life Cycle. Introduction; Information Security Policy, Standards, and Practices

Unit – II: Classical Encryption Techniques **5 Hrs**

Symmetric Cipher Model- Cryptography, Cryptanalysis and Brute-Force Attack, Block Ciphers and the Data Encryption Standard - Traditional Block Cipher Structure- Stream Ciphers and Block Ciphers, Feistel Cipher Structure, The Data Encryption Standard-Encryption and Decryption, Advanced Encryption Standard-AES, International Data Encryption Algorithm(IDEA).

Unit – III : Public Key Cryptography **10 Hrs**

Public Key Cryptography and RSA Principles of Public-Key Cryptosystems-Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA algorithm-Algorithm, Computational Aspects, The security of RSA, Other Public key cryptography algorithms- Diffie-Hellman Key Exchange

Unit – IV: Cryptographic Hash Functions **10Hrs**

Cryptographic Hash Functions Applications of Cryptographic Hash Functions, Secure Hash Algorithms-SHA-512 Logic, Message Authentication Codes – Message Authentication Requirements, Message Authentication FunctionsMessage Encryption, Message Authentication Code, Digital Signatures-Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, Remote Authentication: KERBEROS.

Unit –V : Transport Layer Security and Network Security Applications **5 Hrs**

Web Security Considerations, Secure Socket Layer, Transport Layer security, HTTPS, Secure ShellSSH. Pretty good privacy, notation, operational description. Block chain: Introduction to block chain, types of block chain.

Unit 6: Advance Networking with Case Studies in IoT/Cloud Computing/ Mobile Computing 10Hrs

Cloud Computing: Virtual Machine Management: Configuration, Placement and Resource Allocation. Creating and Configuring Hyper-V Network Virtualization, Overview of Backup and Restore Options for Virtual Machines, Protecting Virtualization Infrastructure by Using Data Protection Manager. Power efficiency in Virtual Data centers, Fault Tolerance in Virtual Data Centres. Networking: Layers and Functions, switching techniques, Addressing, Routing Protocols, Quality of Services, Network Virtualization, Recent research trends. Performance of Computer Network. Cloud Concept and their implementations using NS2/NS3 or Cloud Sim. Implementation of Flooding, Link state, Distance Vector routing protocols for mobile ad-hoc network using NS2/NS3

Reference Books

1. Cryptography And Network Security, Principles And Practice Sixth Edition, William Stallings, Pearson
2. Information Security Principles and Practice By Mark Stamp, Willy India Edition
3. Cryptography & Network Security, Forouzan, Mukhopadhyay, McGrawHill
4. Cryptography and Network Security AtulKahate, TMH
5. Cryptography and Security, C K Shyamala, N Harini, T R Padmanabhan, Wiley-India
6. Information Systems Security, Godbole, Wiley-India
7. Computer Networking *A Top Down Approach* by James F. Kurose and Keith W. Ross, 6th Edition, Pearson.
8. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini, ZaighamMahmood, Prentice Hall.

Course III

Compu.Sci. CW 3.3: **Artificial Intelligence and Machine Learning**
Total No.hours : 45 hrs
Duration: 3hours Max. Marks: 100

COURSE OUTCOMES (COs)

CO 1: Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO 2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO 3: Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

CO 4: Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.

CO 5: Demonstrate proficiency in applying scientific method to models of machine learning.

CO 6: Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications

Unit-I: **10 hrs**

Introduction: Introduction to AI applications and AI techniques, Production systems, control strategies, reasoning - forward and backward chaining. Intelligent Agents: Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates.

Unit-II: **10 hrs**

Searching Techniques and Game Playing: Breadth first search, depth first search, iterative deepening, uniform cost search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, Best first search, A* algorithm, AO* algorithm, Minimax and game trees, refining minimax, Alpha - Beta pruning, constraint satisfaction.

Unit-III: **10 hrs**

Knowledge Representation: First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, PROLOG, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies. Planning: basic representation for planning, symbolic-centralized vs. reactive-distributed, partial order planning algorithm.

Unit-IV: **10** hrs

Machine learning: Introduction to different types of learning, Supervised and Unsupervised learning — Reinforcement learning- Basics of Neural network models.

Unit-V: **05 hrs**

Applications of Artificial Intelligence- Natural Language Processing, Speech recognition, Computer vision, Expert systems.

REFERENCE:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach (3rd ed.), Pearson Education, 2010.
2. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, 2002.
3. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, Inc., San Francisco, California, 2000.

Course – Compu.Sci. CW 4: Research and Publication Ethics (RPE)

Duration: 2hours Max. Marks: 50

Total No. hours: **30 hrs**

COURSE OUTCOMES (COs)

CO 1: Make research scholars to acquaint themselves with the publication ethics and publication misconducts. .

CO 2: A combination of Lectures, Interaction, Case Analysis, Group Discussion, Seminars, Assignments and practical sessions.

Unit – 1: Philosophy and Ethics: Introduction to Philosophy – Definitions – Nature and Scope – Concept – Branches. Ethics – Definition – Moral Philosophy – Nature of moral Judgements and Reactions. **5hrs**

Unit -2: Scientific Conduct: Ethics with respect to science and research – Intellectual Honesty and Research Integrity Scientific Misconducts: Falsification – Fabrication and Plagiarism - Redundant Publications: Duplicate and Overlapping Publications - Salami Slicing- Selective Reporting and Misrepresentation of Data. **5hrs**

Unit -3: Publication Ethics: Definition – Introduction and Importance – Best Practices / Standards Setting Initiatives and guidelines: COPE, WAME – Conflict of Interest – Publication Misconduct: Definition – Concept – Problems that lead to unethical behaviour and Vice versa – Types - Violation of Publication Ethics – authorship and Contributorship – Identification of Publication Misconduct – Complaints and Appeals – Predatory Publishers and Journals. **5 hrs**

Unit -4: Open Access Publishing: 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 – Journal Finder / Journal suggestions tools viz. JANE – Elsevier Journal Finder – Springer Journal Suggester etc. **5 hrs**

Unit -5: Publication Misconduct:

A. Group Discussions:

Subject Specific Ethical Issues - FFP – Authorship - Conflicts of Interest – Complaints and Appeals: Examples and Fraud from India and Abroad.

B. Software Tools:

Use of Plagiarism Software Like Turnitin – Urkund and other open-Source Software Tools. **5 hrs**

Unit -6: Databases and Research Metrics:

A. Databases:

Indexing Databases – Citation Databases – Web of Science – Scopus Etc

B. Research Metrics:

Impact Factor of Journal as per Journal Citation Report – SNIP – SJR – IPP- Cite score – Metrics – H-Index - g index – i10 index – Altmetrics **5 hrs**