

KARNATAKUNIVERSITY, DHARWAD



*Department of Computer Science*

*Revised Syllabus of  
Course Work for Ph.D Programme  
in Computer Science*



From  
2021-22 onwards

## **PROGRAMME SPECIFIC OUTCOMES (PSOS)**

After completion of this programme, the student will be able to:

1. Model computational problems by applying mathematical concepts and design solutions using suitable data structures and algorithmic techniques.
2. Design and develop solutions by following standard software engineering principles and implement by using suitable programming languages and platforms.
3. Develop system solutions involving both hardware and software modules

### **Program Educational Objectives (PEOs)**

1. Achieve professional competency in the field of Computer Science.
2. Acquire domain knowledge to pursue higher education and research.
3. Become socially responsible engineers with good leadership qualities and effective interpersonal skills.

**Karnatak University, Dharwad**  
Department of Computer Science

Course Work for Ph.D Programme

(W.e.f.2021-22 and onwards)  
Course Structure and Scheme of Examination

| Sl No. | Course                            | Paper Code No.   | Name of the Course                                  | Contact hours per week | Maximum Marks              |                        |       | Examination hours |
|--------|-----------------------------------|------------------|---|------------------------|----------------------------|------------------------|-------|-------------------|
|        |                                   |                  |   |                        | Continuous Assessment (IA) | Course end examination | Total |                   |
| 01     | Course I: Research Methodology    | Comp. Sc. CW 1   | Research Methodology                                | 03                     | 50                         | 50                     | 100   | 02                |
| 02     | Course II: Cognate/ Core Subjects | Comp. Sc. CW 2   | Concrete Mathematics                                | 03                     | 50                         | 50                     | 100   | 02                |
| 03     | Course III: Area of Research      | Comp. Sc. CW 3.1 | Digital Image Processing and Pattern Classification | 03                     | 50                         | 50                     | 100   | 02                |
|        |                                   | Comp. Sc. CW 3.2 | Information and Network Security                    |                        |                            |                        |       |                   |
|        |                                   | Comp. Sc. CW 3.3 | Artificial Intelligence and Machine Learning        |                        |                            |                        |       |                   |
|        |                                   |                  |   |                        | 150                        | 150                    | 300   |                   |
|        |                                   |                  |   |                        |                            |                        | 50    |                   |
|        |                                   |                  |   |                        |                            |                        | 350   |                   |

Continuous Internal Assessment (IA) Marks of the course work shall be awarded based on

- |  |   |                  |
|--|---|------------------|
| (a) Assignments – 10 marks<br>(b) Seminar – 10<br>(c) Tests - 30 | } | Total – 50 marks |
|--|---|------------------|

| Sl No. | Paper                             | Internal Assessment Components (Marks) |                      |                       |                       |       |
|--------|-----------------------------------|--|----------------------|-----------------------|-----------------------|-------|
|        |                                   | Test –I (15)                           | Test –II (15)        | Seminar (10)          | Assignment (10)       | Total |
| 01     | Course I: Research Methodology    | 5 <sup>th</sup> Week                   | 9 <sup>th</sup> Week | 12 <sup>th</sup> Week | 14 <sup>th</sup> Week | 50    |
| 02     | Course II: Cognate/ Core Subjects | 5 <sup>th</sup> Week                   | 9 <sup>th</sup> Week | 12 <sup>th</sup> Week | 14 <sup>th</sup> Week | 50    |
| 03     | Course III: Area of Research      | 5 <sup>th</sup> Week                   | 9 <sup>th</sup> Week | 12 <sup>th</sup> Week | 14 <sup>th</sup> Week | 50    |

**Course I**  
**Compu.Sci. CW 1: RESEARCH METHODOLOGY**

**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 social 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**

**08hrs.**

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**

**12hrs**

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**

**08 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**

**10 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, Rajeeb Dey, Valentina E. Balas.
3. Kothari C.K. (2004) 2/e, Research Methodology – Methods and Techniques (New Age International, New Delhi).
4. Montgomery, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India).
5. Montgomery, 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: 48

#### 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 of the master theorem.

#### **UNIT-V**

**8 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<sup>th</sup> Ed 2003
2. Introduction to Algorithms Thomas H Cormen, Charles E Leiserson, Ronald L Rivest PHI S<sup>th</sup> Ed 2003

3. Discrete Mathematical Structure Bernard Kolinan, Robert C Busby, Sharon Ross, PHI S" Ed 2000 4.  
"Introduction 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 : 48 hrs

#### 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.**

#### UNIT I

6 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

12 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, 3rd Edition, 2008.
2. Milan Sonka, Václav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision". Cengage Learning: 4th edition (January 2014)
3. Anil K. Jain. "Fundamentals of Digital Image Processing", Prentice-Hall of India Pvt. Ltd., 1997.
4. Richard O. Duda, Peter E. Hart, David G. Stork. "Pattern Classification", John Wiley & Sons, 2nd 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**

**Total No. hours : 48 hrs**

#### **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.**

#### **Unit – I : Basics of Information Security**

08Hrs

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**

10 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**

08 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 Functions Message Encryption, Message Authentication Code, Digital Signatures-Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, Remote Authentication: KERBEROS.



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.

**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 Atul Kahate, TMH
5. Cryptography and Security, C K Shyamala, N Harini, T R Padmanabhan, Wiley-India
6. Information Systems Security, Godbole, Wiley-India

**Course III****Compu.Sci. CW 3.3 :Artificial Intelligence and Machine Learning****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:****12 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:****12 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:****07 hrs**

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

**Unit-V:****07 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.