KARNATAKUNIVERSITY, DHARWAD

Department of Computer Science

Revised Syllabus of
Course Work for Ph.DProgramme
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.DProgramme

(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	

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

(a) Assignments – 10 marks
(b) Seminar – 10
(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	5th Week	9th Week	12th Week	14th Week	50
02	Course II: Cognate/ Core Subjects	5th Week	9th Week	12th Week	14th Week	50
03	Course III: Area of Research	5th Week	9th Week	12th Week	14th 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, 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: 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 tnclusion-Exclusion.
Relations: Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence.Relations, Partial Ordérings.

UNIT-111 **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 ol 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" 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 : 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.

UNITI 6 Hrs

Introduction: Definition,Origin,andExamplesofDigitalImageProcessing,Fundamental " StepsinDigital 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: Boundaryfollowing, 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,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

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 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 12Hrs

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 AtulKahate, 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 profciency developing applications in an 'AI language', expert system shell, or data mining tool.

CO 5: Demonstrate profciency in applying scientifc 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.