

Department of Computer Science & Applications
A

Revised Syllabus of

Ph. D. Course Work

in

Computer Science

Approved by BOS on 05-05-2016.

(With effective from July 2016)



Session 2016-2017 and onwards
DR. HARISINGH GOUR UNIVERSITY, SAGAR (M.P)

(A Central University)

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R. K. Katore

{ External Expert
Prof. R. K. Katore
Prof. in Computer Science
A. P. S. University, Rewa

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
DR. HARISINGH GOUR UNIVERSITY, SAGAR (M.P)

Summary of Ph.D. Course Work (One Semester) in Computer Science

From July 2016 and onwards

Course Code	Title of Paper	Credits
Compulsory to all		
CSA-C-141	Research Methodology	4
CSA-C-142	Data Structure and Design Analysis of Algorithms	4
CSA-C-143	Review of Published research work	8
Opt any one of the followings		
CSA-E-1401	Data Mining	4
CSA-E-1402	Advance Computer Networks	4
CSA-E-1403	Parallel Computing	4
CSA-E-1404	Advance Operating System	4
CSA-E-1405	Graph Theory and Combinatorics	4
CSA-E-1406	Advanced Pattern Recognition	4
CSA-E-1407	Stochastic Modeling & Simulation	4
CSA-E-1408	Compiler Design	4

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Ph. D. Coursework I Semester

CSA-C- 141	Research Methodology	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT - I Introduction to Research Methodology: Types of Research, Significance & Status of Research, Major Research areas in relevant subject, Major Journals & Publications, Identification & selection & formulation of a research problem, Hypothesis formulation, Developing a research proposal, Resources and Tools in research. Role of empirical studies, Ethics in general, Ethical issues and professional conduct in research, General moral imperatives.

UNIT - II Qualitative and Quantitative Reasoning: Qualitative Representations, Representing Mathematical Relationship, State, Time and Behaviours, Space and Shape, Modeling Assumptions, Model Formulation, Model development and testing, Reasoning Techniques, Causal Reasoning, Simulation, Comparative Analysis.

UNIT -III Data Analysis: What is data, Mathematical statistics, Statistical tools and techniques, Method for aggregation and visualization, Methods for finding associations: correlation and regression, Hypothesis testing, Statistical tests and pattern recognition.

UNIT -IV Literature Survey: Literature search strategy, writing critical reviews, identifying venues for publishing your research. Quality majors in research like impact factor, some research quality indicators, Abstracting and Indexing of Journals and Research papers

Writing Research Papers and Review Process: Preparing, writing and presenting research paper. conference paper, Importance of references, making use of referees' reports. Journal review process, Group exercise in reviewing research papers.

Thesis Writing: Planning the thesis, writing the thesis, Thesis structure, Writing up schedule, Oral examination and Viva Voce.

Books and References:

1. Research Methods By Francis C. Dane, Brooks/ Cole Publishing Company, California.
 2. Basic of Qualitative Research (3rd Edition) By Juliet Corbin & Anselm Strauss, Sage Publications (2008)
 3. The Nature of Research: Inquiry in Academic Context By Angela Brew, Routledge Falmer (2001)
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Ph. D. Coursework I Semester

CSA-C-142	Data Structure and Design Analysis of Algorithms	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I **Singly Linked Lists:** Circular Linked Lists- Doubly Linked Lists – linked List in Array, Polynomial representation and addition. Array Representation and Implementation of stack, Operations on Stacks: Push & Pop, Linked Representation of Stack and Operations Associated with Stacks, Applications of stack: Conversion of Infix to prefix and Postfix Expressions, Evaluation of postfix expression using stack. Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queue, Deque and Priority Queue.

UNIT -II **Introduction and basic concepts:** Complexity measures, worst-case and average-case complexity functions, problem complexity, quick review of basic data structures and algorithm design principles. Sorting and selection: Finding maximum and minimum, k largest elements in order; Sorting by selection, tournament and heap sort methods, lower bound for sorting, other sorting algorithms - radix sort, quick sort, merge sort; Selection of k-th largest element. Searching and set manipulation: Searching in static table- binary search, path lengths in binary trees and applications, optimality of binary search in worst case and average-case, binary search trees, construction of optimal weighted binary search trees; Searching in dynamic table -randomly grown binary search trees, AVL. Hashing: Basic ingredients, analysis of hashing with chaining and with open addressing.

Union-Find problem: Tree representation of a set, weighted union and path compression-analysis and applications.

UNIT -III **Graph problems:** Graph searching- BFS, DFS, shortest first search, topological sort; connected and biconnected components; minimum spanning trees - Kruskal's and Prim's algorithms- Johnson's implementation of Prim's algorithm using priority queue data structures. Algebraic problems: Evaluation of polynomials with or without pre-processing. Winograd's and Strassen's matrix multiplication algorithms and applications to related problems, FFT, simple lower bound results.

UNIT-IV **String processing:** String searching and Pattern matching, Knuth-Morris-Pratt algorithm and its analysis.

NP-completeness: Informal concepts of deterministic and nondeterministic algorithms, P and NP, NP-completeness, statement of Cook's theorem, some standard NP-complete problems, approximation algorithms.

Books and References:

1. A. Aho, J. Hopcroft and J. Ullman; The Design and Analysis of Computer Algorithms, A.W.L, International Student Edition, Singapore.
2. S. Baase: Computer Algorithms: Introduction to Design and Analysis, 2nd ed., Addison-Wesley, California.
3. T. H. Cormen, C.E. Leiserson and R.L.Rivest: Introduction to Algorithms, Prentice Hall of India, New Delhi.
4. E. Horowitz and S. Sahni: Fundamental of Computer Algorithms, Galgotia Pub./Pitman, New Delhi/London.
5. K. Mehlhorn: Data Structures and Algorithms, Vol. 1 and Vol. 2, Springer-Verlag, Berlin.

Approved by BOS on 05-05-2016.

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Ph. D. Coursework I Semester

CSA-C-143	Review of Published research work	Credit: 4	L	T	P	C
		Max. Marks : 100	-	-	-	8

This paper will be covered under assignment mode and under minor thesis work. The candidate will write research paper for publication.

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Ph. D. Coursework I Semester

CSA-E-1401	Data Mining	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I **Data warehouse:** The building Blocks- Defining Features, data warehouses and data marts, overview of the components and metadata in the data warehouse. Defining the business requirements: Dimensional analysis, information packages- a new concept, requirements gathering methods, requirements **Definition:** scope and content. Data warehouse architectures: Metadata, operational data & operational databases. Data warehouse architecture model, 2-tier, 3tier & 4 tier data warehouses. OLAP and DSS support in data warehouses. Principles of dimensional modeling: Objectives, From Requirements to data design, the STAR schema, STAR Schema Keys, Advantages of the STAR Schema Dimensional Modeling: Updates to the Dimension tables, miscellaneous dimensions, the snowflake schema, aggregate fact tables, and families of STARS.

UNIT-II **Data Mining:** Basic concept, technology and rules, platform tools, operational vs. Information systems, discussion of ethics & privacy issues with respect to invasive use, Data pre-processing and cleaning, Data visualization and exploratory data analysis.

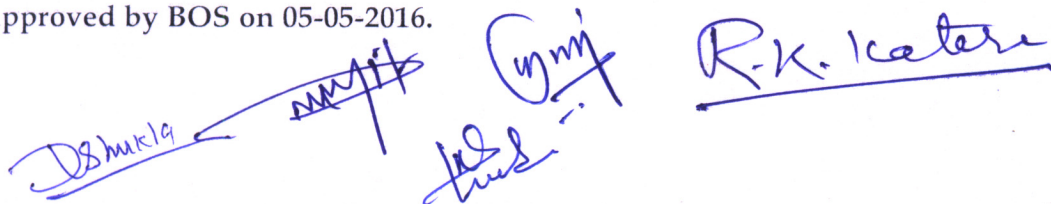
UNIT -III **Data mining techniques:** Exploration of data mining methodologies, decision tables, Decision trees, classification rules, association rules, clustering, statistical models & linear models, Performance evaluation.

UNIT -IV **Web mining:** Introduction to web mining techniques, web basics and HTTP, data Sources on the web, personalization, working with logs, forms and cookies, user identification and path analysis, E-Metrics, Any other current topics on Data Mining.

Books and References:

1. Jiawei Han, Micheline Kamber and Jian Pei (2011) Data Mining: Concepts and Techniques.
 2. Matthew North (2012) Data Mining for the Masses.
 3. Pang Ning Tan, M Steinbach, Vipin Kumar, Introduction to Data Mining, Addison Wesley.
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The block contains four handwritten signatures in blue ink. From left to right, they are: 'D. Shukla', a signature that appears to be 'S. K. Singh' with a large 'X' over it, 'Gymj' (likely G. N. Jha), and 'R. K. I卡特' (likely R. K. I卡特). The signatures are written in a cursive, handwritten style.

Ph. D. Coursework I Semester

CSA-E-1402	Advanced Computer Network	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I Computer Networks and the Internet: History of Computer Networking and the Internet, Networking Devices, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones.

Networking Models: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM.

UNIT -II Network Routing: Routing and its concepts: Structure of a Router, Basic Router Configuration, Building a Routing Table, Static Routing, Dynamic Routing - Distance Vector Routing Protocol (RIPv1, RIPv2, EIGRP), Link State Routing Protocols (OSPF).

UNIT-III LAN Switching: Switching and its concepts: Structure of a Switch, Basic Switch Configuration, Virtual LANs (VLANs), VLAN Trunking Protocol (VTP), Spanning Tree Protocol (STP), Inter-VLAN Routing.

Wide Area Networks (WANs): Introduction to WANs, Point-to-Point Protocol (PPP) concepts, Frame Relay concepts, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), IPv6.

UNIT -IV Network Programming using Java: TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI) - Basic RMI Process, Implementation details - Client-Server Application.

Books and References:

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Fifth Edition, Pearson Education.
 2. Network Fundamentals, Mark Dye, Pearson Education.
 3. Routing Protocols & Concepts, Rick Graziani, Pearson Education.
 4. LAN Switching & Wireless, Wayne Lewis, Pearson Education.
 5. Accessing the WAN, Bob Vachon, Pearson Education.
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Ph. D. Coursework I Semester

CSA-E-1403	Parallel Computing	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I **Parallel Computer:** Concept, need and requirement, various concepts in pipelining, issues involved in complex pipelining, configuring a parallel computer, Parallel Architecture: Vector processor, message passing and shared memory multiprocessors, Permutation.

UNIT -II **Programming:** Using sequential computing elements, data flow approach. Elementary Algorithms: Matrix manipulation, Graph connectivity and traversal, Tree traversal, Sorting and searching on PRAM.

UNIT -III **Complexity of Parallel algorithms:** Various processor interconnection schemes: mesh, hypercube, perfect shuffle etc., High Performance Computing approach for complex problems: problems in Computational Geometry, Permutations and Combinations, Fourier transforms, traversing combinational spaces, Decision and Optimization.

UNIT-IV **Task Scheduling:** DAG, Priority of task, Homogenous and heterogeneous scheduling, different scheduling algorithms.

Books and References:

1. Ratan Ghosh, Rajat Moona, Phalguni Gupta, "Foundation of Parallel Processing" NAROSA.
 2. V. Rajaraman "Elements of Parallel Computing" PHI.
 3. Selim Akl, "The Design and Analysis of Parallel Algorithms", PHI.
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Ph. D. Coursework I Semester

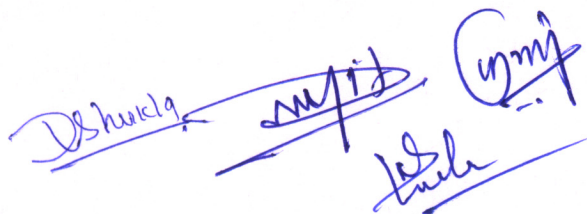
CSA-E-1404	Advanced Operating System	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

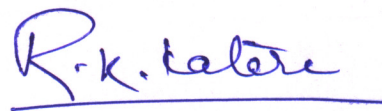
- UNIT -I **Device Drivers. Message Passing:** Inter-process communication, group communication, broadcasting algorithms. Remote Procedure Call: RPC Model, stub generation, server management, parameter passing, call semantics, communication protocols, client-Server binding, exception handling, security, optimization.
- UNIT-II **Distributed Shared Memory:** Architecture, consistency model, replacement strategy, thrashing, coherence, Naming in distributed systems, directory services, DNS. Synchronization: Clock synchronization, event ordering, mutual exclusion, deadlock, election algorithms.
- UNIT-III **Resource Management:** Scheduling algorithm, task assignment, load balancing, load sharing. Process Management: Process migration, threads. File Systems. Protection and Security. Fault Tolerance.
- UNIT-IV **Real time OS:** pSOS, VxWorks, Case studies of some distributed OS: Hydra, Mach, Amoeba, etc.

Books and References:

1. A. S. Tanenbaum: Distributed Operating Systems, Prentice Hall of India, New Delhi.
 2. G .F. Colouris, J. Dollimore and T. Kindberg: Distributed Systems: Concepts and Design, 2nd ed., Addison-Wesley, Reading, Mass.
 3. S. J. Mullender (Ed.): Distributed Systems: An Advanced Course, 2nd ed., Addison-Wesley, Reading, Mass.
 4. P. K. Sinha: Distributed Operating Systems, IEEE Press, Los Alamos, California
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Ph. D. Coursework I Semester

CSA-E-1405	Graph Theory and Combinatorics	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I **Graph Theory:** Connectivity, Matchings, Hamiltonian Cycles, Colouring Problems.

UNIT -II Network flows, special classes of graphs, Introduction to Graph Minor theory.

UNIT -III **Combinatorics:** Basic Combinatorial Numbers, Recurrence Relations, Inclusion- Exclusion Principle, Introduction to Polya Theory.

UNIT-IV **Probabilistic Method in Graph theory:** Basic Method, Expectation, Chernoff bound, Lovasz Local Lemma.

Books and References:

1. J. H. Van Lint, R. M. Wilson, A Course in Combinatorics, Cambridge University Press, 1993
 2. N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd edition, 2000
 3. R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000
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R. K. Kataria

Ph. D. Coursework I Semester

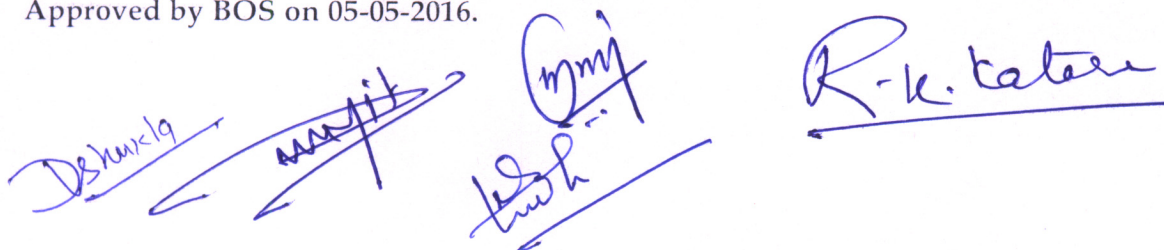
CSA-E-1406	Advanced Pattern Recognition	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

- UNIT -I Bayes classification, error probability, error bounds, Bhattacharya bounds, error rates and their estimation, parametric and nonparametric learning, density estimation, estimation of mixture distributions, classification trees.
- UNIT -II Unsupervised classification, split/merge techniques, advanced hierarchical clustering algorithms, cluster validity, set estimation, optimal and suboptimal feature selection algorithms, k-NN rule and its error rate. Syntactic approach to pattern recognition.
- UNIT -III Neural network models for pattern recognition; learning, supervised and unsupervised classification, stochastic learning algorithm, feature analysis, fuzzy set theoretic models for pattern recognition.
- UNIT -IV Some advanced topics with applications, (e.g., neuro-fuzzy approach, genetic algorithms, data mining, case-based reasoning). Use of PR software.

Books and References:

1. K. Fukunaga: Introduction to Statistical Pattern Recognition, Academic Press, New York.
2. M. R. Anderberg: Cluster Analysis for Applications, Academic Press, New York, 1973.
3. A. K. Jain and R. C. Dubes: Algorithms for Clustering Data, Prentice Hall, Englewood Cliffs.
4. R. C. Gonzalez and M. G. Thomason: Syntactic Pattern Recognition: An Introduction, Addison-Wesley, Reading, Mass.
5. K. S. Fu: Syntactic Pattern Recognition and Applications, Prentice Hall, Englewood Cliffs.
6. J. C. Bezdek: Pattern Recognition with Fuzzy Objective Function Algorithms, Plenum Press, New York.
7. G. J. Klir and B. Yuan: Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, Englewood Cliffs.
8. B. D. Ripley: Pattern Recognition and Neural Networks, Cambridge University Press, London.
9. Y-H. Pao: Adaptive Pattern and Neural Networks, Addison-Wesley, New York.
10. R. J. Schalko: Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley.

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Ph. D. Coursework I Semester

CSA-C- 1407	Stochastic Modeling & Simulation	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT -I Basics of Stochastic modeling, Markov chain theory, application of Markov chains, Transition Probability, Homogenous and non homogenous chains.

UNIT -II Stochastic Poisson process, different Poisson process dependent models. Parameter based probability distributions in Poisson Processes.

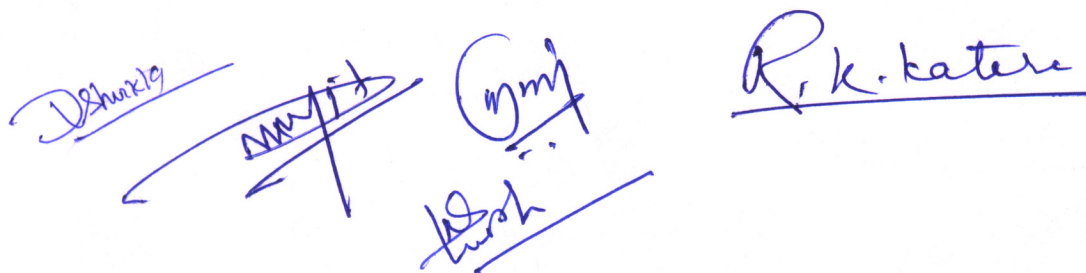
UNIT -III Switching system, Different types of switches, stochastic modeling of switches, Modeling of space division switch, Modeling of Knockout Switch.

UNIT -IV Stochastic modeling of different network systems, use of transition probabilities in modeling of computer system, Study of Internet traffic share problem, Modeling & characterization of network traffic problems.

Books and References:

1. System Simulation : Neelam Kavi.
 2. System Simulation : Gorden.
 3. Research Papers on Stochastic Modeling & Simulation.
 4. Research papers on modeling of switching system
 5. Research papers on Internet traffic sharing.
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Ph. D. Coursework I Semester

CSA-E-1408	Compiler Design	Credit: 4	L	T	P	C
		Max. Marks : 100	4	0	0	4

UNIT-I **Introduction:** Compiler, phases and passes, bootstrapping, finite state machines and regular expressions and their applications to lexical analysis, implementation to lexical analyzers, lexical-analyzer generator; LEX-compiler, formal grammars, and their application to syntax analysis, BNF notation, ambiguity, LL(k) and LR(k) grammar, bottom-up and top-down parsers, operator precedence, simple precedence, recursive descent and predictive parsers, LR(k) parsers, parse table generation, YACC.

UNIT -II **Syntax directed translation:** Quadruples, triples, 3-address code, code generation for standard constructs with top-down and bottom-up parsers, translation of procedure calls, record structuring.

Code optimization: Loop optimization, DAG analysis, loop identification by flow dominance, depth-first search, reducible flow graphs, legal code motion, induction variables, data flow analysis, u-d and d-u chains, copy propagation, elimination of global sub-expressions, constant folding, code hoisting, forward and backward data flow equations, inter procedural data flow analysis.

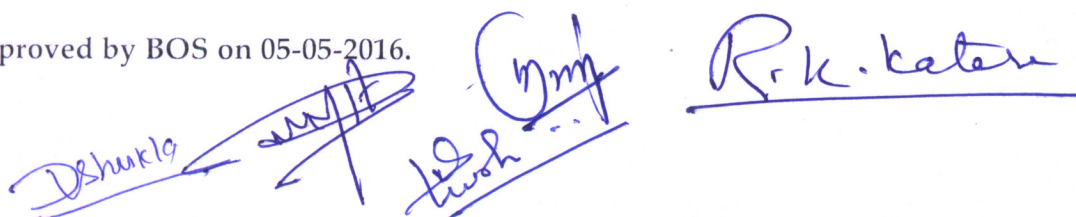
UNIT -III **Code generation:** Problems in code generation, code generator, register assignment and allocation problems, usage count, code generation from DAG, peephole optimization.

UNIT-IV **Symbol table:** Data structure and management, runtime storage administration, error detection and recovery; Lexical, syntactic and semantic errors, case studies with real life compilers.

Books and References:

1. A. V. Aho, R. Sethi and J. Ullman: Compilers: Principles, Techniques and Tools, Addison-Wesley, California.
 2. A. Appel: Modern Compiler Implementation in Java, Cambridge Univ. Press, London.
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