PhD Scheme and Syllabus (Computer Science & Engineering)

S. No.	Course No.	Course Title	Teaching Schedule	
			L	P
1.	TRM 701	RESEARCH METHODOLOGY	4	-
2. 1	TCS 801	SOFTWARE VERIFICATION, VALIDATION & TESTING	4	-
3.	TCS 802	PROGRAMMING PARADIGMS	4	-
4. 2	TCS 803	ADVANCED DATA STRUCTURES AND ALGORITHMS	4	-
5. 3	TCS 804	DISTRIBUTED DATABASE	4	-
6. 4	TCS 805	DISTRIBUTED SYSTEM AND APPLICATION	4	-
7. 5	TCS 806	ENERGY EFFICIENT COMPUTING TECHNOLOGY	4	-
8. 6	TCS 807	RELIABLE COMPUTING	4	-
9.	TCS 808	PARALLEL ALGORITHMS	4	-
10. 7	TCS 809	APPROXIMATION ALGORITHMS	4	-
11.	TCS 810	NATURAL LANGUAGE PROCESSING	4	-
12.	TCS 811	CASE STUDY (SEMINAR +IMPLEMENTATION)		4

w.e.f: 2012-13

TCS 801: Software Verification, Validation & Testing
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
4	-	4	Class Work	:50 Marks
			Exam.	:100 Marks
			Total	:150 Marks
			Duration of Exam	: 3 Hrs.

Unit 1

Introduction: What is software testing and why it is so hard?, Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing, No absolute proof of correctness, Overview of Graph Theory.
Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

Unit 2

Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing.
Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing.

Unit 3

Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, and Slice based testing
Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing.

Unit 4

Testing Tools: Static Testing Tools, Dynamic Testing Tools, and Characteristics of Modern Tools and Implementation with example.Advanced topics in software testing: web based testing, Client server testing, Automated test cases generation, Regular expression and FSM based testing.

Reference and Text Books

1. William Perry, Effective Methods for Software Testing , John Wiley & Sons, New York, 1995.
2. Cem Kaner, Jack Falk, Nguyen Quoc, Testing Computer Software , Second Edition, Van Nostrand Reinhold, New York, 1993.
3. Boris Beizer, Software Testing Techniques , Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
4. Louise Tamres, Software Testing , Pearson Education Asia, 2002
5. Roger S. Pressman, Software Engineering – A Practitioner's Approach , Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.
6. Boris Beizer, Black-Box Testing – Techniques for Functional Testing of Software and Systems , John Wiley & Sons Inc., New York, 1995.

7. K.K. Aggarwal & Yogesh Singh, Software Engineering , New Age International Publishers, New Delhi, 2003.

TCS 802: Programming Paradigms
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
4	-	4	Class Work	:50 Marks
			Exam.	:100 Marks
			Total	:150 Marks
			Duration of Exam	: 3 Hrs.

Objective: To introduce semantics of programming languages and develop skills in describing, analyzing and using the features of programming languages.

Unit-1

Introduction to different paradigms of programming -Imperative - Object Oriented – Functional- Logic.

Unit-2

Imperative and Object-oriented Programming - Role of Types - Static and Dynamic Type Checking - Scope rules; Grouping Data and operations, Information Hiding and Abstract Data Types, Objects, Inheritance, Polymorphism, Templates.

Unit-3

Functional Programming - Expressions and Lists, Evaluation, types, type systems, values and operations, function declarations, lexical scope, lists and programming with lists, polymorphic functions, higher order and Curried functions, abstract data types.

Unit-4

Logic Programming - Review of predicate logic, clausal-form logic, logic as a programming language, Unification algorithm, Abstract interpreter for logic programs, Semantics of logic programs.

Books for references

1. Ravi Sethi, Programming Languages: Concepts and Constructs, 2nd Edition, Pearson Education Asia.
2. Alfred. V. Aho and Jefferey. D. Ullman, Foundations of Computer Science, Computer Science Press, 1992.
3. Stephen G. Kochan, Programming in C, Third Edition, July 2004, Pearson Education.
4. R. B. Patel, Programming in C, 1st edition Khanna Book Publishing Company Pvt. Ltd, New Delhi, 2008.

5. Kernighan and Ritchie, C Programming Language, 2nd Edition, Prentice Hall, Inc., 1988.
6. Byron S. Gottfried, Programming with C, TMH

TCS 803: Advanced Data Structures and Algorithms
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
4	-	4	Class Work	:50 Marks
			Exam.	:100 Marks
			Total	:150 Marks
			Duration of Exam	: 3 Hrs.

Unit 1

Review of Basic Concepts: Abstract data types, Data structures, Algorithms, Big Oh, Small Oh, Omega and Theta notations, Solving recurrence equations, Master theorems, Generating function techniques.

Unit 2

Advanced Search Structures for Dictionary ADT: Splay trees, Amortized analysis, 2-3 trees, 2-3-4 trees, Red-black trees, Skip lists, Universal hash functions.

Unit 3

Advanced Structures for Priority Queues and Their Extensions: Binomial heaps, Leftist heaps, Skewed heaps, Fibonacci heaps and its amortized analysis, Applications to minimum spanning tree algorithms

Unit 4

Graph Algorithms: DFS, BFS, Bi-connected components, Cut vertices, Matching, Network flow. Lower Bound Theory: Adversary arguments, information theory bounds

Reference and Text Books

1. Mark Allen Weiss, Data Structures and Algorithms in C++, Addison Wesley, 2003.
2. Adam Drozdek, Data Structures and Algorithms in C++, Brooks and Cole, 2001.
3. Aho, Hopcroft and Ullmann, Data structures and Algorithm, Addison Welsey, 1984.
4. A. M. Tenenbaum, Langsam, Moshe J. Augentem, Data Structures using C, PHI Pub.
5. R. B. Patel, Expert Data Structure with C, , 3rd Pub, Khanna Pub. Pvt Ltd.
6. A. V. Aho, J. E. Hopcroft and T. D. Ullman, Data Structures and Algorithms, Original edition, Addison-Wesley, 1999, Low Price Edition.
7. Ellis Horowitz & Sartaj Sahni, Fundamentals of Data Structure , Pub, 1983. AW
8. Horowitz Sahni and Rajasekaran Sanguthevar,Fundamentals of computer algorithms , University press (India) Limited.
9. Robert Kruse, Data Structure and Program design in C , PHI
10. Jean Paul Tremblay, Richard B. Bunt, Introduction to Computer Science- An algorithms approach, 2002, T.M.H.
11. Willam J. Collins, Data Structure and Standard Template Library, 2003, T.M.H

TCS 804: Distributed Database
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
			Class Work	**:50 Marks**
4	**-**	**4**	**Exam.**	**:100 Marks**
			Total	**:150 Marks**
			Duration of Exam	**: 3 Hrs.**

Distributed and parallel databases concepts – autonomy, distribution, and heterogeneity.Client/server, parallel and distributed architectures. Design strategies. Horizontal, vertical andhybrid fragmentation. Resource allocation. Transaction model, serialization and recovery.Concurrency control, Deadlock management and Distributed deadlock, reliability and availability,load balancing, Schema translation & Integration, multi databases and multi-dimensional indices.

Reference Books:

1. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. "Database Systems Concepts,
4/e.," McGraw-Hill Publishers. Copyright 2001. ISBN 0-07-228363-7.
2. Ozsu, M. Tamer and Patrick Valduriez' "Principles of Distributed Database Systems, 2/e,"Prentice Hall Publishers. Copyright 1999. ISBN 0-13-659707-6.

TCS 805: Distributed System & Application
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits	Class Work :50 Marks
4	-	4	Exam. :100 Marks
			Total :150 Marks
			Duration of Exam : 3 Hrs.

UNIT 1

INTRODUCTION :Introduction to Distributed systems-examples of distributed systems, challenges-architectural models- fundamental models - Introduction to interprocess communications-external data representation and marshalling- client server communication-group communication – Case study: IPC in UNIX

UNIT 2

DISTRIBUTED OBJECTS AND FILE SYSTEM :Introduction - Communication between distributed objects - Remote procedure call - Events and notifications - Java RMI case Study - Introduction to DFS - File service architecture - Sun network file system - Introduction to Name Services- Name services and DNS - Directory and directory services

UNIT 3

DISTRIBUTED OPERATING SYSTEM SUPPORT :The operating system layer – Protection - Process and threads - Communication and invocation - Operating system architecture - Introduction to time and global states - Clocks, Events and Process states - Synchronizing physical clocks - Logical time and logical clocks - Global states - Distributed debugging – Distributed mutual exclusion.

UNIT 4

TRANSACTION AND CONCURRENCY CONTROL – DISTRIBUTED TRANSACTIONS

Transactions – Nested transaction – Locks - Optimistic concurrency control - Timestamp ordering Comparison of methods for concurrency control - Introduction to distributed transactions - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery

UNIT 5

SECURITY AND REPLICATION :Overview of security techniques - Cryptographic algorithms Digital signatures - Cryptography pragmatics – Replication - System model and group communications – Fault tolerant services – Highly available services – Transactions with replicated data George Coulouris, Jean Dollimore, Tim Kindberg “Distributed Systems Concepts and Design” Third Edition – 2002- Pearson Education Asia.

REFERENCES

1. A.S.Tanenbaum, M.Van Steen " Distributed Systems" Pearson Education 2004.
2. Mukesh Singhal, Ohio State University, Columbus "Advanced Concepts In Operating Systems" McGraw-Hill Series in Computer Science, 1994

TCS 806: Energy Efficient Computing and Technologies
Ph. D Course Work (Computer Science & Engg.)

L	P	Credits	Class Work :50 Marks
4	-	4	Exam. :100 Marks
			Total :150 Marks
			Duration of Exam : 3 Hrs.

Objective: To expose the students basic to some advanced features of different types of ad hoc networks with case studies. It also gives a direction to the students about distributed system design model & implementation.

Unit 1

Overview of Ad Hoc Networks: Why Ad Hoc Networks?, Challenges, and benefits of Mobile Computing, Breakthrough Technology, Wireless Computing, Nomadic Computing, Mobile Computing, Ubiquitous Computing, Pervasive Computing, Invisible Computing, Applications of mobile computing, Wireless and Mobile Computing Models, LAN Protocols: IEEE 802.11/a/g/n & Bluetooth, Data Management Issues. Sensor Networks- Challenges, Architecture, and Applications.

Unit 2

Routing: Taxonomy, Applications, Challenges in Mobile Environments, Hidden and exposed terminal problems, Routing Protocols- Proactive, Reactive, and Hybrid protocols, Dynamic State Routing (DSR), Ad hoc On-Demand Distance Vector (AODV), Destination Sequenced Distance – Vector Routing (DSDV), and Cluster Based Routing Protocol (CBRP), and Temporally Ordered Routing algorithm (TORA).

Unit 3

Distributed location Management: Pointer forwarding strategies, Process communication techniques, socket programming, Remote Procedure Call (RPC), Remote Method Invocation (RMI), client/server programming, Mobile IP- Problem with Mobility, Terminology, Operation, Tunneling, Data transfer to the mobile system, Transport Control Protocol (TCP) Over wireless- Indirect TCP (I-TCP), Snoop TCP, Mobile TCP (M-TCP), Case Study of Client/Server architecture.

Unit 4

Fault tolerance and Security: Mobile Agents Computing, Security- Issues and Mechanisms, Certificate, Secure Agent Transfer, Timestamp Tamper-proofing, Secure Agent Reception, Host Protection, Providing Security and Integrity to Agent Data and State, Securing Agent Itineraries, Security Architecture, fault tolerance- Issues and Mechanisms, Agent Failure Scenarios, Node (host) Failure Detection and Recovery, Agent Failure Detection and Recovery, Communication Failure Detection and Recovery, Fault Tolerant System-3-Layered Monitor System, transaction processing in Mobile computing environment. Mobile Agent Systems: Aglets, PMADE and Case Study.

Reference and Text Books

1. Charles E. Perkins, Ad hoc Networks, Addison Wesley, 2008.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley, 2007.
3. Mazliza Othman, Principles of mobile computing and communications, Auerbach Publications, 2007.
4. Uwe Hansmann, Lothar Merk, Martin Nicklous, Thomas Stober, Principles of Mobile computing, 2nd Ed., Wiley, 2006.
5. Daniel Minoli, A Networking Approach to Grid Computing, Wiley, 2004.
6. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff UNIX Network Programming: The Sockets Networking API, Volume 1, Third Edition: Addison Wesley, 2003.
7. Lange, D.B. and Oshima, M., Programming and Deploying Java Mobile Agents with Aglets, 1st Ed., Addison Wesley, 2001.
8. William T. Cockayne, Michal Zyda, Mobile agents, Manning Publication, 2000.
9. Milojicic, D., Douglis, F. and Wheeler R., (ed.), Mobility Processes, Computers and Agents, Addison Wesley, 1999.

TCS 807:**Reliable Computing**

Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
			Class Work	**:50 Marks**
4	**-**	**4**	**Exam.**	**:100 Marks**
			Total	**:150 Marks**
			Duration of Exam	**: 3 Hrs**

Unit 1

Reliability: Definition, System reliability, Parameter values, Reliability models for hardware redundancy – Testing: Various testing methods.

Unit 2

Fault tolerance: Definition, Fault types, Detection, Redundancy, Data diversity, Reversal checks, Byzantine failures, Integrated failure handling.

Unit 3

Real Time system: Introduction, Characterizing real time systems, Performance measures for real time systems, Estimating Program run times, Task management and Scheduling – Uni-processor, Fault tolerant scheduling.
Real Time Communications: Protocols, Contention based, token based, Stop and go multihop, the polled bus, hierarchical round robin, deadline based, and fault tolerance routing, Distributed delay constrained method, Dependable real time channels, recovery approach, Establishing real time channels.

Unit 4

Programming Languages and Tools: Desired Language Characteristics, Data typing, control structures, Hierarchical decomposition, Packages, Exception handling, Over loading and Generics, Multi tasking, Task scheduling, Timing specification., Flex, Euclid, Environments, Run time support.

Reference and Text Books

1. C. M. Krishna and K. G. Shin, 'Real time Systems', McGraw Hill International Edition, 1997.
2. C. Siva Ram Murthy and G. Manimaran, 'Resource Management in Real Time Systems and Networks', The MIT Press, 2001.
3. Phillip A. Laplante, 'Real-Time Systems Design and Analysis – An Engineers Hand book', Printice Hall India, III edition, 1997.

TCS 808:**Parallel Algorithms**

Ph. D Course Work (Computer Science & Engg.)

L	P	Credits	Class Work	:50 Marks
4	-	4	Exam.	:100 Marks
			Total	:150 Marks
			Duration of Exam	: 3 Hrs

Introduction to data and control parallelism. PRAM model and its variants, EREW, ERCW, CRCW, PRAM algorithms, cost optimality criterion, Brent's theorem and its importance.

Processor organizations such as mesh and hypercube, embedding of problem graphs into processor graphs.. Parallel algorithms for matrix multiplication, merging and sorting for different processor organizations such as mesh and hypercube. Introduction to distributed systems, synchronous / asynchronous network models, leader election problem in ring and general networks; Type of faults, fail safe systems, Byzantine faults, distributed consensus with link and process failures.Algorithms for BFS, DFS, shortest paths and spanning trees in distributed systems. Asynchronous networks: Broadcast and multicast, logical time, global snapshot and stable properties; Network resource allocation.

Name of Books / Authors Year of Publication

1. Quinn, M. J., "Parallel Computing Theory & Practice",McGraw-Hill 1994
2. Horowitz, E., Sahni, S. and Rajasekaran, S., "Computer Algorithms: C++", Galgotia Publications 2002
3. Lynch, N. A., "Distributed Algorithms", Morgan Kaufmann. 2003
4. Miller, R. and Boxer, L., "Algorithms Sequential & Parallel: A Unified Approach" , 2nd Ed., Charles River Media

TCS 809: Natural Language Processing

Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
			Class Work	**:50 Marks**
4	**-**	**4**	**Exam.**	**:100 Marks**
			Total	**:150 Marks**
			Duration of Exam	**: 3 Hrs**

Objective: To acquaint the students with the concepts, algorithms and applications of natural languages.

Unit 1

Issues & Motivation: Issues; Motivation; Features of Indian Languages; Issues in Font; Coding Techniques; Sorting & Searching Issues.
Morphology & parts of speech: Phonology; Words & Morphemes; Segmentation; Categorization and Lemmatization; Parts of Speech; Taggers; Rule Based; Hidden Morkov Models; Morphology Issues of Indian Languages; Transliteration.

Unit 2

Syntax & Semantics: Basic Concept of Syntax; Parsing Techniques; Lexicalized & Probabilistic Parsing; General Grammar Rules for Indian Languages; Semantics; Pragmatics; Fundamentals; Syntax & Semantics; Indian Language View Point; Statistical Techniques in Corpus Based Techniques.

Unit 3

Mobile application Architecture and Messaging: Building Indian Language Interfaces to Standard Packages; Multilingual Issues; Specialized Tools for Indian Language Processing; GIST Cards; ISCII & Unicode Issues for Indian Languages; Speech Processing & Text to Speech Issues in Indian Languages.

Unit 4

Application: Online Education Tools in Indian Languages; Web Libraries; IT in Rural, Medical & E - Governance Application in Local Languages; Automatic Taggers; Natural Language Generation; Machine Translation; Information Extraction; Retrieval; Other Applications in Indian Languages.

Books

1. James Allen, "Natural Language Understanding", Benjamin & Cummings Publishing Co., 1995
2. Ronald Hausser, "Foundations of Computational Linguistics", Spring & Verleg, 1999
3. Daniel Jurafskey & James H. Martin, "Speech & Language Processing", Prentice Hall of India, 2000
4. Steve Young & Gerrit Bloothoof, "Corpus Based Methods in Language & Speech Processing", Kluwer Academic Publishers, 1997.

TCS 810: Approximation Algorithms

Ph. D Course Work (Computer Science & Engg.)

L	P	Credits		
			Class Work	**:50 Marks**
4	**-**	**4**	**Exam.**	**:100 Marks**
			Total	**:150 Marks**
			Duration of Exam	**: 3 Hrs**

Contents. NP-hardness and approximation algorithms. Different kinds of approximability. Linear programming and Duality. Randomized Rounding. Covering and packing problems, Facility location, machine scheduling and bin packing, Primal dual approximation algorithms in graph connectivity and Networks design. Multi-commodity flows and cuts. Graph embeddings and their application to sparsest cuts, separators and bandwidth minimization. Feedback arc sets and linear ordering problems, Shop scheduling: Open, flow and job shop. Semi definite programming and application to max-cut graph colouring. Concept of best possible approximation algorithm, Hardness of approximations.

TCS 811: Case Study(Seminar + Implementation)

Ph. D Cours

e Work (Computer Science & Engg.)

L	P	Credits		
			Class Work	**:50 Marks**
4	**-**	**4**	**Exam.**	**:100 Marks**
			Total	**:150 Marks**
			Duration of Exam	**: 3 Hrs**

Concerned Teachers/Experts in the selected area must be identified by a scholar for approval of the case study topic. A Scholar is required to analyze and implement the given case study topic and submit **Three** copies of bound report of given case study topic **One** week before the presentation to office of Head/Concerned faculty (examiner) appointed by the Head.

Few Problems for Case Studies as follows:

Objective: To give the scholar practice in writing various phases of mobile, wireless, software systems & techniques, etc

1. Design a prototype that implements the Cache management for a mobile computing environment?

2. Design a System: The challenges of developing high performance, high reliability, and high quality software systems are too much for ad hoc and informal engineering techniques that might have worked in the past on less demanding systems. New techniques for managing these growing complexities are required to meet today's time-to-market, productivity and quality demands.

3. Peer-to-peer communication system: As computers become more pervasive and homes become better connected, a new generation of applications will be deployed over the Internet. In this model, peer-to-peer applications become very attractive because they improve scalability and enhance performance by enabling direct and real-time communication among the peers. We need to propose a decentralized management system that manages the peer-to-peer applications and the system resources in an integrated way; monitors the behavior of the peer-to-peer applications transparently and obtains accurate resource projections, manages the connections between the peers and distributes the objects in response to the user requests and changing processing and networking conditions.

4. Write programs that implement the few sorting algorithms (bubble, selection, etc) for n data. It stops the operation when the counter for sorting index is at 100, 1000, 10000 and so on, stores the contents of the registers, program counter and partially sorted list of data, etc. It resumes the operation after 30 sec from the point of the termination.

5. Write a program that implements the bubble sort for n data. It stops the operation when the counter for sorting index is at 100, 1000, 10000, and so on, stores the contents of the registers, program counter and partially sorted list of data, etc. It transfers the code and data across the network on the new destination and resumes the operation from the point of termination on the previous node. Finally the result from the last node in the itinerary is sent back to the process-initiating node.

6. Develop a prototype that performs parallel computation of the same task on different nodes. Finally process initiator (master node) receives the result and computation time required to complete the task on an each node and displays to the user. Compare the computing power of different nodes.

Books

1. Mobility: Processes, Computers, and Agents, Dejan Milojicic, Frederick Douglis, Richard Wheeler, Addison-Wesley Professional; 1st edition (April 19, 1999).
2. Ivan Stojmenovic´ (Editor), Handbook of Wireless Networks and Mobile Computing, Wiley, ISBN: 0-471-41902-8, February 2002
3. Core Java Volume I and II from Sun Micro Systems.
4. Huges, Java Networking, Hut Publication, Pune
5. Java 2: The Complete Reference 4/e; Herbert Schildt, TMH, Delhi.
6. Java Beans Programming from the Ground Up: Joseph O'Neil, TMH, Delhi
7. Java Servlets: Application Development; Karl Moss, TMH, Delhi