M. Tech. DEGREE
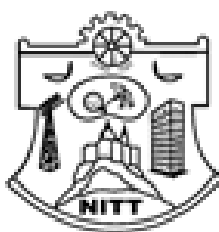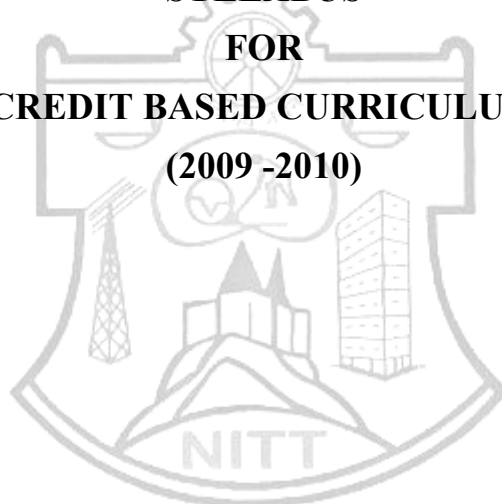
COMPUTER SCIENCE

SYLLABUS
FOR
CREDIT BASED CURRICULUM
(2009 -2010)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI – 620 015, INDIA.

M. Tech. (Computer Science)

The total minimum credits required for completing the M. Tech (Transportation Engineering and Management) Course is 61.

SEMESTER I

Code	Course of Study	L	T	P	C
CS701	Advanced Concepts in Operating Systems	3	0	0	3
CS703	Parallel Computer Architecture	3	0	0	3
CS705	Advanced Data Structures And Algorithms	3	0	0	3
CS707	Software Systems Laboratory	0	0	3	2
	Elective - 1	3	0	0	3
	Elective - 2	3	0	0	3
		17	**0**	**3**	**17**

SEMESTER II

Code	Course of Study	L	T	P	C
CS702	Advanced Concepts in Database Systems.	3	0	0	3
CS704	Distributed Systems	3	0	0	3
CS706	Advanced Digital Design	3	0	0	3
	Elective - 3	3	0	0	3
	Elective - 4	3	0	0	3
	Elective - 5	3	0	0	3
	Seminar	2	0	0	2
		20	**0**	**0**	**20**

SEMESTER III

Code	Course of Study	L	T	P	C
CS747	Project Work – Phase I	0	0	24	12

SEMESTER IV

Code	Course of Study	L	T	P	C
CS748	Project Work – Phase II	0	0	24	12

ELECTIVES (I Semester)

Code	Course of Study	L	T	P	C
CS711	Fault tolerant computing systems	3	0	0	3
CS713	Design and analysis of parallel algorithms	3	0	0	3
CS715	Advanced network principles and protocols	3	0	0	3
	Any Elective from the other department	3	0	0	3

ELECTIVES (II Semester)

Code	Course of Study	L	T	P	C
CS714	Real-time systems	3	0	0	3
CS716	Network security	3	0	0	3
CS718	Mobile network systems	3	0	0	3
CS720	Wireless sensor networks	3	0	0	3

CS701. ADVANCED CONCEPTS IN OPERATING SYSTEMS (3-0-0) 3

Multiprocessor operating system - Multiprocessor system architecture, structure, processor scheduling and allocation, memory management.

Distributed operating system- characteristics - Design issues communication models - clock synchronization - Mutual exclusion Election Algorithms.

Distributed Deadlocks detection - Distributed scheduling - Distributed File system - Distributed shared memory.

Multimedia Files, Video compression, Process Scheduling, File System, File placement, Caching, Disk Scheduling.

Real Time Operating System: Scheduling mechanisms, Interrupts, Memory management, I/O & networking, resource reservation.

Case studies: Open source software, LINUX, Open SOLARIS

TEXT BOOK

1. M Singhal and NG Sivaratri, Advanced Concepts in Operating Systems, Tata McGraw Hill Inc., 2001
2. A.S. Tanenbaum, Distributed Operating system, Pearson Education Asia, 2001.

REFERENCE BOOK

1. *SILBERSCHATZ and P. GALVIN, Operating System Concepts, VI **edition**, Addison Wesley 2004.*

CS703. PARALLEL COMPUTER ARCHITECTURE (3-0-0) 3

Task of a Computer Designer - Measuring and Reporting PerformanceQuantitative Principles of Computer Design.

Shared-memory and distributed memory architectures - Taxonomy of MIMD computers

Parallel processing applications - Performance metrics - Speedup performance laws.

Instruction set architecture - Design considerations - CISC & RISC processors -Virtual Memory - Cache memory organization.

Review of the ABCs of Cache Performance **issues -** Main Memory and Organization for Improving Performance - Memory Technology.

Instruction Level **Parallelism** - Concepts and Challenges - Dynamic Scheduling: Examples and Algorithm - Dynamic Hardware Prediction - Multiple Issue - Harware Based Speculation.

Basic Complier Techniques for Exposing ILP-Static Branch Prediction - the VLIW Approach

- Advanced Compiler Support of Exposing ILPHardware Support for Exposing More Paralleslism at Compile Time Hardware Vs Software Speculation.

TEXT BOOK

1. D.A. Patterson, JL.Hennessy, "Computer Architecture : A Quantitative approach" Elsevier 3rd Edition 2003.
2. K.Hwang, Advanced Computer Architecture, Parallelism, Scalability, Programmability, "McGraw Hill, 1993 ".

CS705. ADVANCED DATA STRUCTURES AND ALGORITHMS (3-0-0) 3

Development of Algorithms - Notations, Concepts. Storage structures for arrays-Stacks, Queues: Representations and applications.

Linked lists - Linked stacks and queues - Operations on Polynomials Dynamic storage management - Garbage collection and compaction.

Trees - Tree Traversing - Operations on Binary Trees -height balanced trees - graphs and representive graph algorithms.

Selection, Bubble, Insertion, Merge, Heap, Quick, Radix and address calculation - Linear and Binary Searching - Related analysis -Some advanced data structures.

Divide and Conquer method - Greedy Method - Dynamic Programming – Backtracking Branch and Bound Techniques for Lower Bound, Game Trees.

TEXT BOOK

1. T. H Cormen, C.E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms ", Prentice Hall of India, 2001.
2. G. Brassard and Bratley, Fundamentls of Algorithmics, Prentice. Hall 1996.

REFERENCE BOOK

1. Sara Baase, Allen Van Gelder, "Computer Algorithms: Introduction to design and Analysis ", 31 Edition, Addison Wesley, 2000.

CS707. SOFTWARE SYSTEMS LABORATORY (0-0-3) 2

Object-Oriented Programming: Lab exercises in C++/Visual C++, MFCS. Design of Object oriented Software, Lab exercises in shell programming. LINUX Tools: Grep, AWK., TR, MAKE, System calls, Network Programming - Client Server Programming Using Sokets Web Programming.

REFERENCE BOOKS

1. Chris H.Pappas & William Murray-Hill, "Visual C++ 6 The Complete Reference ", TMH Publishers, 2001.
2. Steven Prata, "Advanced UNIX-A Programmer's Guide ", BPB Publications, 1992.

3. D.E. Comer, David, I. Stevens, Internetworking with TCP / IP, Vol-3, Client Sover Programming and Application, Prentice Hall of India, 2000.
4. W.R. Stevens, UNIX, Networking Programming, Prentice Hall of India 1999.

CS702. ADVANCED CONCEPTS IN DATABASE SYSTEMS (3-0-0)3

Memory hierarchy - Data formats - file structures - Indexes -B-trees Hash tables - external sorting.

Evaluation of relational operators - Algorithms. Query optimization Use of Heuristics - Cost Estimations.

Transaction concept - Schedules - Serializability. Concurrency control techniques: Timestamp based - Lock based - Optimistic - Multiversion.

Guidelines for index selection - Clustering and indexing - Index tuning, Conceptual Schema tuning, Tuning queries and views.

Log based recovery - undo, redo, undo/redo - logging - Shadow paging - media recovery. Applications: Data Mining, Data warehousing, Web databases.

TEXT BOOKS

1. A.Silberschaiz, HF. Korth, S.Sudarshan, "Database System Concepts ", 3rd edition, McGraw Hill, 1997
2. R. Elmasri and S. B. Navathe, "Fundamentals of Database System", 2nd edition, The Benjamin /Cummings Publishing Co., 1994.

REFERENCE BOOK

1. CJ Date, "Database an Introduction to Database Systems ", 8th edition, Addison Wesley, 2003.

CS704. DISTRIBUTED SYSTEMS (3-0-0)3

Distributed Systems: Goal, Advantages, Organization of Multiprocessor Systems and related Hardware and Software Concepts, Design Issues.

Communication - Layered protocols, RPC, RMI, Message oriented communication, Stream oriented communication, Process - Threads, Clients, Servers, Code Migration, Software agents, Naming - entities, locating mobile entities, removing unreferenced entities

Security, Distributed database systems - CORBA, Distributed COM, Distributed GLOBE, Comparision of CORBA, DCOM, and GLOBE, Distributed File Systems - SUN network file system, CODA file system, other distributed file systems and their comparison.

Distributed document based systems- Word Wide Web, Lotus notes, Distributed Coordination based systems – Introduction, TIB / RENDEZVOUS, JINI and their comparison.

Case Studies : From the Internet - OPEN SOURCE Security, Distributed database systems - CORBA, Distributed database systems, CORBA, Distributed COM, GLOBE, Comparision of CORBA, DCOM, and GLOBE

TEXT BOOK

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed System Principles and Paradigms", Pearson education, 2002.

REFERENCE BOOK

1. G Coulouris, J. Dollimore, "T. Kindberg, "Distributed System Concepts and Design, 4th Edition, Addison Wesley, 2005.
2. M. Reynal, "Distributed Algorithms and Protocols", John Wiley, 1988.

CS706: ADVANCED DIGITAL DESIGN (3-0-0)3

Review of Combinational and Sequential logic design, Structural models of combinational logic, Propagation delay, Behavioral Modeling, Boolean equation based behavioral models of combinational logic, Cyclic behavioral model of flip-flop and latches, A comparison of styles for behavioral modeling, Design documentation with functions and tasks

Synthesis of Combinational and Sequential logic - Introduction to synthesis, Synthesis of combinational logic, Synthesis of sequential logic with latches, Synthesis of three-state devices and bus interfaces, Synthesis of sequential logic with flip-flops, Registered logic, State encoding, Synthesis of gated clocks and clock enables, Anticipating the results of synthesis, Rests, Synthesis of loops, Design traps to avoid, Divide and Conquer: partitioning a design.

Design and Synthesis of Datapath Controllers- Partitioned sequential machines, Design example: Binary counter, Design and synthesis of a RISC stored-program machine, Design example - UART.

Programmable Logic and Storage Devices-Programmable logic devices, Storage devices, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Programmability of PLDs, Complex PLDs, Introduction to Altera and Xilinx FPGAs, Algorithms, Nested loop programs, and data flow graphs, Pipelined Architectures, Circular buffers, FIFOs and Synchronization across clock domains.

Architectures for Arithmetic Processors - Functional units for addition and subtraction, Functional units for multiplication, Multiplication of signed binary numbers, Multiplication of fractions, Functional units for division.

TEXT BOOK

1. Michael ciletti, "Advanced Digital Design with the Verilog HDL, Pearson Education, 2003.

REFERENCE BOOK

1. Samir Palnitkar "Verilog HDL ", Pearson Education, 2003.

2. Stephenbrown, "Fundamentals of Digital Logic with Verilog " Tata McGraw-Hill-2003.
3. J. Bhasker, "A Verilog HDL Primer" Star Galaxy Publishing, 1999
4. Michael D. Ciletti, "Modeling, Synthesis, and Rapid Prototyping with the Verilog HDL " Prentice Hall, 1999

SEMINAR

Students are required to take up a topic of their choice, and by surveying the research done on that topic, they should give a minimum of two presentations. The Students will be required to submit a summary report / paper on the topic.

ELECTIVES FOR FIRST SEMESTER

CS711. FAULT TOLERANT COMPUTING SYSTEMS (3-0-0) 3

Introduction: Computer and Computation Distribution, System models and Fault models. Test generation for combinational circuits, sequential circuits and Fault simulation.

Fault Tolerance Concepts- Recovery in time, Fault detection techniques, Modeling Fault-tolerant systems - Rollback modular redundancy and Exception Handling.

Fault Tolerant in Real time Systems - Architecture of Fault - tolerant computers general-purpose commercial systems - High availability systems - Critical computations

Fault Tolerant multiprocessor - Communication Architectures, Shared memory

Interconnections, loop architectures, Tree Networks, Graph Network and in Binary cube interconnection.

Fault Tolerant Software - **Design** of fault Tolerant software - Reliability Models,

Construction of acceptance tests, validation of Fault tolerant software.

TEXT BOOKS

1. Israel & Krishnan, "Fault Tolerant Systems" Elsevier Publications, 2007.
2. D. K. Pradhan, "Fault Tolerant computing - Theory and Techniques "Prentice Hall.Inc. 1986.

REFERENCE BOOKS

1. Levi & Agrawala, "Fault Tolerant Systems Design, McGraw hill, 1994.
2. MA. Breuer and A.D.Friedman, "Diagnosis and Reliable design of Digital Systems", Computer Sci. Press, 1976.

CS713. DESIGN AND ANAL YS1S OF PARALLEL ALGORITHMS (3-0-0) 3

Introduction to Parallel computers - SIMD - EREW, CREW SM-SIMD algorithms - shared memory SIMD, Tree and mesh interconnection computers.

Sorting - Sorting **on a Linear** Array**, Sorting on** a Mesh, **Sorting on** EREW SIMD **computer**, MIMD **Enumeration** Sort, MIMD Quick sort. Sorting on other Networks.

Matrix operations - Mesh Transpose, Shuffle Transpose, EREW transpose - Mesh. multiplication, Cube multiplication - Matrix by vector Multiplication Tree Multiplication.

Numerical problems- Linear. Equations - SIMD algorithm- Roots of Nonlinear Equations - MIMD algorithm- partial Differential Equations, computing Eigen values.

Graph Theoretical Problems - computing the connectivity matrix. Finding connected components, Traversing. The minimal Alpha-Beta Tree, Storage requirements.

TEXT BOOKS

1. S.G. Akl, "The Design and Analysis of Parallel Algorithms", Prentice Hall of India. 1989.
2. S. G. Akl, "Parallel Sorting Algorithms ", Academic Press, 1985.

REFERENCE BOOKS

1. S. Lakshmivarahan and S.Kdhall, "Analysis and Design of Parallel Algorithms - Arithmetic and Matrix Problems ", McGraw Hill, 1990.

CS715. ADVANCED NETWORK PRINCIPLES AND PROTOCOLS (3-0-0) 3

Introduction to Networks -Application of Networks - Architecture Topology Switching - SLIP, PPP -ALOHA protocols, CSMA/CD, IEEE 802.3, 802.4, 802.5

Network Layer **Issues-** Routing, Congestion control- Internetworking - Issues, Address Learning Bridges, Spanning tree, Source routing, Bridges, Routers, Gateway.

Network Protocol- IP datagram - hop by hop routing, ARP, RARP, DHCP -Sub net Addressing, Address Masking, ICMP, RIP, RIPV2, OSPF, DNS, LAN and WAN Multicast.

Transport Layer- Design issues, Connection Management, Transmission Control Protocol (TCP) - User Datagram Protocol (UDP).

Application Layer Protocol- Telnet - TFTP - FTP - SMTP - Ping Finger, Bootstrap Network Time Protocol- SNMP.

TEXT BOOK

1. S. Tanenbaum, "Computer Networks ", Third Edition, Prentice Hall India, 1997.

REFERENCE BOOK

1. W Richard Stevens, "TCP/IP Illustrated -Volume I, The protocols ", Addition-Wesley Professional Computing Series, 1994.

ELECTIVES FOR SECOND SEMESTER

CS714. REAL-TIME SYSTEMS (3-0-0) 3

Introduction to Real-time computing - Structure of a Real-Time System Characterization of Real-Time Systems and tasks - Performance **measures.**

Task Assignment and Scheduling- Uniprocessor scheduling Algorithms - Task Assignment - Mode Changes - Fault Tolerant Scheduling.

Real-Time Communication - Network topologies and Architecture Is**sues -** Protocols Contention-based, Token-based, polled bus and Fault Tolerant routing.

Real-Time Databases - Transaction Priorities and Aborts - Concurrency control Issues Scheduling Algorithms - Two-phase approach to improve predictability.

Programming Languages and Tools - Hierarchical decomposition - RunTime error handling - Overloading - Timing specification - Recent trends and developments.

TEXT BOOK

1. CM Krishna and Kang G Shin, "Real-Time Systems", International Editions, ISBN-0-07114243-6, McGraw Hill Companies, Inc., New York, 1997

CS716. NETWORK SECURITY (3-0-0) 3

Introduction to Classical and Modem techniques - Attacks, services and mechanisms, classical encryption techniques, DES, Block cipher design principles and modes of operation.

Encryption Algorithms and Hash Functions - Triple DES, RC5, key management, Public key. Cryptography RSA Algorithm, Digital signatures and authentication protocols.

System Security - Backups, integrity management, protecting against programmed threats, viruses and worms, physical security, personnel security.

Network Security - Protection against eavesdropping, security for modems, IP security, web security, electronic mail security, authentication applications.

Security tools - Firewalls, wrappers, proxies, discovering a break-in, denial of service attacks and solutions, Cryptographic security tools: KERBEROS, PGP, SSH, SRP, OPIE.

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security Principles and Practice ", 11 Edition, Pearson Education Asia Publishers (Low priced Edition), 2000, Ch 1 to 16.
2. Simson Garjainkal, and Gene Spafford, "Practical UNIX and Internet Security" 2nd edition Oreilly Pule Pvt. Ltd. 2000

REFERENCE BOOK

1. Steve Burnett and Stephene Paine, "RSA Security 's official guide to cryptography", RSA Press, Tata McGraw Hill Edition, 2001.

CS718. MOBILE NETWORK SYSTEMS (3-0-0) 3

Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems- - fre,.quency reuse, co-channel interference.

Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls-initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff.

Mobile Telecommunication standards, satellite and broadcast systems - GSM, DECT, TETRA, IMT-2000, CTEO, LEO and MEO, - IEEE 802.11, HIPERLAN, Bluetooth.

Network support for mobile systems - Cellular analog, MTSO interconnection, reverse tunneling, IPV6, DHCP, Wireless ATM-W ATM services, functions, radio access layer.

Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, W W W, W AP.

TEXT BOOK

1. Jochen Sciiiller, "Mobile Communications ", Pearson Education Asia Publications (Low Price Edition), 2000, Ch 1 to 11.

REFERENCE BOOK

1. William C.Y Lee, "Mobile Cellular Telecommunications ", McGraw Hill International 'Editions, 1995, Ch 1, 2, 8, 9, 11.

CS720: WIRELESS SENSOR NETWORKS (3-0-0)3

Introduction : Fundamentals of wireless communication technology, the electro magnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issuess in adhoc wirelesss networks, issues in design of sensor network, sensor network archeitecture, data dissemination and gathering.

MAC Protocols : Issues in desiging MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Routing Protocols : Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

TEXT BOOK

1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", pearson Education - 2008.

REFERENCE BOOK

1. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
2. Jochen Schiller, "Mobile Communications ". Pearson Education, 2nd Edition, 2003.
3. William Stallings, "Wireless Communications and Networks ", Pearson Education - 2004