Teaching Scheme of M.Tech (Computer Engineering)
(Full Time)

Semester I

Sr.No.	Course No.	Title	L	T	P	CW*	Exam	Total
1.	1MCS1	Advanced Data Structures	3	1		25	100	125
2.	1MCS2	Software System Design	3	1		25	100	125
		Elective-I	3	1		25	100	125
3.	1MCS3.1	Modern Compiler Design						
4.	1MCS3.2	Critical System Design						
5.	1MCS3.3	Mathematical Foundation of Computing						
		Elective-II						
6.	1MCS4.1	High Level System Design And Modeling	3	1		25	100	125
7.	1MCS4.2	Information System Security	3	1		25	100	125
8.	1MCS4.3	Grid Computing	3	1		25	100	125
		Sessionals						
9.	1MCS5	Software System Lab			3	60	40	100
		Total	12	4	3	160	440	600

Semester II

Sr.No.	Course No.	Title	L	T	P	CW*	Exam	Total
1.	2MCS1	Advanced Database Management Systems	3	1		25	100	125
2.	2MCS2	Design of Embedded Systems	3	1		25	100	125
3.	2MCS3	Distributed Algorithms	3	1		25	100	125
		Elective-I						
4.	2MCS4.1	Advanced Computer Graphics	3	1		25	100	125
5.	2MCS4.2	High-Performance Scientific Computing	3	1		25	100	125
6.	2MCS4.3	Advanced Real-Time System Design	3	1		25	100	125
		Sessionals						
7.	2MCS5	Advanced Database Lab			3	60	40	100
		Total	12	4	3	160	440	600

Semester III

Sr.No.	Course No.	Title	L	T	P	CW*	Exam	Total
1.	3MCS1	Parallel and Distributed Computing	3	1		25	100	125
		Elective						
2.	3MCS2.1	Reconfigurable Computing	3	1		25	100	125
3.	3MCS2.2	Artificial Intelligence & Fuzzy Systems	3	1		25	100	125
4.	3MCS2.3	Network System Design	3	1		25	100	125
		Sessionals						
5.	3MCS4.1	Seminar	2/2			50	50	100
6.	3MCS4.2	Dissertation Part-I			2	50	50	100
		Total	7	2	2	200	300	450

Semester IV

Sr.No.	Course No.	Title	L	T	P	CW*	Exam	Total
1.	4MCS1	Dissertation Part-II			9	250	250	500
		Total			9	250	250	500

CW-> Course Work.

1MCS1: Advanced Data Structures

Course No.: 1MCS1 **Course Title:** Advanced Data Structure
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Advanced data structures: self-adjustment, persistence and multidimensional trees. Randomized algorithms: Use of probabilistic inequalities in analysis & applications. Geometric algorithms: Point location, convex hulls and Voronoi diagrams, Arrangements. Graph algorithms: Matching and Flows. Approximation algorithms: Use of Linear programming and primal dual, local search heuristics. Parallel algorithms: Basic techniques for sorting, searching, merging, list ranking in PRAMs and Interconnection networks.

Suggested reference materials:

1. Motwani and Raghavan "Randomized Algorithms", Cambridge University Press
2. Preparata and Shamos "Computational Geometry", Springer Verlag
3. Mehlhorn "Data Structures and Algorithms: 1, Searching and Sorting", Springer Verlag EATCP Monograph on Theoretical Computer Science
4. Papadimitrou and Steiglitz "Combinatorial Optimization", Princeton University Press
5. Joseph Ja'Ja' "Introduction to Parallel Algorithms" Addison-Wesley.
6. Vaizirani "Approximation Algorithms", Springer

1MCS 2: Software System Design

Course No.: 1MCS 2 **Course Title :** Software System Design
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Concepts and techniques relevant to production of large software systems: Structured programming. Requirements, specification and analysis. Top-down design and development. Information hiding, abstraction, modularity, object-oriented techniques. Separate compilation, configuration management, program libraries. Design patterns, UML Documentation. Validation. Quality assurance, safety. Testing and test case generation. Software metrics. Cost analysis and estimation, manpower and time management. Organization and management of large software design projects; use of CASE tools.

Suggested reference materials:

1. Sommerville, "Software Engineering", Addison-Wesley, 1999.
2. Peters and Pedrycz, "Software Engineering: an Engineering Approach", Wiley, 1999.
3. Pressman “Software Engg”, PHI

1MCS3.1: Modern Compiler Design

Course No.: 1MCS3.1 **Course Title:** Modern Compiler Design
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Introduction to Advanced Topics of Informal Compiler Algorithm Notation (ICAN), Control-Flow Analysis, Data-Flow Analysis, Dependence Analysis and Dependence Graphs, Alias Analysis, Introduction to

Optimization, Redundancy Elimination, Loop Optimizations, Procedure Optimizations, Case Studies of Compilers and Future Trends.

Suggested reference materials:

1. Steven S. Muchnick: "Ädvanced Compiler Design and Implementation" Margan Kaufmann.
1. Aho Ullaman Sethi " Compiler Construction" Addition Wesley.
2. Holob " Compiler Designing " TMH.

1MCS3.2: Critical System Design

Course No.: 1MCS3.2 **Course Title:** Critical System Design

L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Introduction to time critical systems, Application, Design Issues, Characterization and classification of time-critical system and tasks, release time, deadlines & timing constraints, reference model, priority assignment & scheduling, clock driven approach, weighted round robbing approach, priority driven approaches, resources & resource access control, assumption on resources & their uses, protocols. Scheduling flexible computations and tasks with temporal distance constraints. Introduction to clock synchronization & Case studies.

Suggested reference materials:

1. J.W.S. Liu "Real-Time Systems", Pearson Education Asia.
2. S.T. Lavi, A. K. Agarawal "Real-Time system design", McGraw Hill
3. P.A. Laplante "Real-Time Systems Design and Analysis, An Engineer's Handbook," IEEE Press.
4. K.Mauch "Real-Time Microcomputer system design, An introduction", McGraw Hill.

1MCS3.3: Mathematical Foundation of Computing

Course No. 1MCS3.3 **Course Title :** Mathematical Foundation of Computing

L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Introduction to Information theoretic and Quantum computing and the notion of an effective procedure. RAM model, Primitive and partial recursive functions, Lambda-calculus, Logic -- completeness and incompleteness, Decidability and Church-Turing hypothesis. Limitations of the standard model. Coding and Information Theory. Thermodynamics of computation. Quantum computation and quantum algorithms. Physical aspects of computation.

Suggested reference materials:

1. Cutland N J "Computability: An Introduction to Recursive Function Theory", Cambridge University Press, 1980.
2. Davis M, Weyuker E J "Computability, Complexity, and Languages", Academic Press, 1983.
3. Boolos G S, Jeffrey R "Computability and Logic", Cambridge University Press, 1989.
4. Hindley R, Seldin J P "Introduction to Combinatory and Lambda-Calculus", Cambridge University Press, 1986.
5. Feynman R P "Lectures on Computation, Penguin", 1996

1MCS4.1: High Level System Design and Modeling

Course No.: 1MCS4.1 **Course Title:** System Level Design and Modeling

L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Introduction to Design Representation of Digital Systems, levels of abstraction, design methodologies, System level methodologies, System specification and design.

Model Taxonomy : State-Oriented models - finite-state machine, Petri net, Hierarchical concurrent finite state machine; Activity-oriented models - Dataflow graph, flow charts; Heterogeneous model - control/data flow graph, Object oriented model, Program-state machine;

Architectural Taxonomy : Application specific architectures - Controller Architecture, Data path architecture, Finite-state machine with data path; Processors - Complex instruction set Computer, Reduced instruction set Computer; Vector machine - Very long instruction word Computer; Parallel processors.

Embedded Systems Specification Requirements Languages : Characteristics of Conceptual models - Concurrency, State Transitions, Hierarchy, Programming Constructors, Behavioral Completion, Communication, Synchronization, Exception handling, Timing; Comparative features of Specification languages - VHDL, Verilog, HardwareC, State-charts, Esterel; Embedded system specification in spec-charts.

A Specification example of Telephone answering machine : Specification capture with spec-charts, Sample test bench, Advantage of executable specifications; Strengths of the PSM model - Hierarchy, State transitions, Programming Constructors, Concurrency, Exception handling, Completion.

System Partitioning: Structural versus functional Partitioning. Partitioning issues - Specification extraction level, Granularity, System Component allocation, Metrics and Estimations, Objective functions and closeness functions, Partitioning Algorithm, Output. Basic Partitioning algorithms - Random mapping, Hierarchical clustering, Multistage Clustering, Group Migration, Radio cut and Simulated Annealing.

Reference Books:

1. Specification and Design of Embedded Systems by Daniel D. Gajski, PTR Prentice Hall Englewood New Jersey

2. High Level System Modeling : Specification and Design Methodologies edited by Ronald Waxman, Kluwer Academic Publishers

1MCS4.2 Information System Security

Course No.: 1MCS4.2 **Course Title :** Information System Security

L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Multi level model of security, Cryptography, Secret Key Cryptography, Modes of Operation, Hashes and Message Digest, Public Key Algorithm, Security Handshake Pitfall, Strong Password Protocol; Case study of real time communication security; Introduction to the Concepts of Security, Security Approaches, Principles of security, Types of attacks; Cryptographic Techniques: Plain text and Cipher text , Substitution Techniques, Transposition Techniques Encryption and Decryption, Symmetric and Asymmetric Key Cryptography. Computer-based symmetric Key Cryptographic; Algorithms**:** Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES); Computer-based Asymmetric Key Cryptographic Algorithms; Cryptography, An Overview of Asymmetric Key Cryptography, The RSA algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm; Public Key Infrastructure (PKI) Digital Certificates, Private Key Management , The PKI Model, Public Key Cryptography Standards (PKCS); Internet Security Protocols Secure Socket Layer (SSL) , Secure Hyper Text Transfer Protocol (SHTTP) , Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL versus SET, 3-D Secure Protocol , Electronic Money , Email Security; User Authentication Mechanisms : Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication; Practical Implementations of Cryptography/Security: Cryptographic Solutions Using Java, Cryptographic Solutions Using Microsoft, Cryptographic Toolkits, Security and Operating Systems; Network Security**:** Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN); Case Studies on Cryptography and Security:

Suggested reference materials:

1. Atul Kahate "Cryptography and Network Security" Tata McGraw-Hill
2. Charlie Kaufman,Radia Perlman,Mike Speciner" Network Securities" Pearson,
3. J. A. Coopeer "Computer Communication Securities"TMH,
4. D.W. Davies W. L. Price "securities For computer Networks"
5. John Wiley Sons, L.Stein "Web Securities A step by step Guide " Addison Wesley.

1MCS4.3: Grid Computing

Course No. 1MCS4.3 **Course Title:** Grid Computing

L-T-P Structure : 3-1-0 **Maximum Marks Theory:** 125

Computational grids; A discussion of the need, potential users and techniques for use of grids. Grid requirements of end users, application developers, tool developers, grid developers, and system managers. Grid Architecture, Networking Infrastructure, Protocols and Quality of Service, Computing Platforms. Operating Systems and Network Interfaces, Compilers, Languages and Libraries for the Grid, Grid Scheduling, Resource Management, Resource Brokers, Resource Reservations, Instrumentation and Measurement, Performance Analysis and Visualization, Security, Accounting and Assurance, The Globus Toolkit: Core systems and related tools such as the Message Passing Interface communication library, the Remote I/O (RIO) library, and the Nimrod parameter study library, Legion and related software, Condor and the Grid, Open Grid Service Architecture and Data Grids, Grid Portal Development.

Suggested reference materials:

1. Peter Pacheco "Parallel Programming with MPI". Morgan Kaufmann.
2. Ian Foster and Carl Kesselman."The Grid: Blueprintf for a New Computing Infrastructure", Morgan Kaufmann.
3. Fran Berman, Geoffrey Fox, and Anthony G. Hey.**"**Grid Computing: Making the Global Infrastructure a Reality".Wiley Series in Communications, Networking, and Distributed Systems.
4. Fran Berman , Geoffrey Fox, Anthony J.G. Hey "Grid Computing: Making The Global Infrastructure a Reality".

Semester-II

2MCS1: Advanced Database Management System

Course No.: 2MCS1 **Course Title:** Advanced Database Management System

L-T-P Structure: 3-1-0 **Maximum Marks Theory: 125**

Overview of DBMS, concurrency control , failure recovery. Introduction to distributed data base management systems, Semantic Database Models and Systems, Object-Oriented Database Systems, Relational Extensions: Design Techniques, Extension Techniques Object / Relational Systems: Open ODB, Transaction Management, Interface, OSQL, Odapter, Case Study of an ORDBMS, Related Development, Current Product Scenario. Standard For OODBMS Products and Applications: ODM – Standards, ODMG, Smalltalk Binding, SQL, User Defined ADT in SQL, Routines, ADT Subtypes and Inheritance, Tables, Procedural Facilities, Other Type Constructions, Generic ADT Packages, Language Bindings.

Suggested reference materials:

1. C S R Prabhu,”Object Oriented Data Base Systems” approaches and Architectures,PHI,
2. F. H. Lochousky, DC Tsichritzis"DBMS" NewYork Academic Press.
3. F. H. Lochousky, DC Tsichritzis"Data Models" PHI.
4. C.J.DATE "Introduction to Data Base to Management System" Addison Wesley.
5. N. Goodman, V. Hadzilacos "Concurrency Control and Recovery in Data Base System" Addison Wesley.

2MCS2 Design of Embedded Systems

Course No.: 2MCS2 **Course Title:** Design of Embedded Systems

L-T-P Structure: 3-1-0 **Maximum Marks Theory: 125**

Embedded Computing Requirements**:** Characteristics and applications of embedded systems; Components of Embedded Systems; challenges in Embedded System Design and design process; Formalism for system design.

Embedded Processors: RISC vs. CISC architectures; ARM processor – processor architecture and memory organization, instruction set, data operations and flow control; SHARC processor – memory organization, data operations and flow control, parallelism within instructions; Input and output devices, supervisor mode, exception and traps; Memory system, pipelining and superscalar execution.

Embedded Computing Platform: CPU Bus – Bus protocols, DMA, system bus configurations, ARM bus; Timers and counters, A/D and D/A converters, Keyboards, LEDs, displays and touch screens; Design examples.

Embedded Software Analysis and Design: Software design pattern for Embedded Systems; Model programs – data flow graphs and control/data flow graphs; Assembly and linking; Compilation techniques; Analysis and optimization of execution time, energy, power and program size.

Embedded System Accelerators: Processor accelerators, accelerated system design

Recommended Book:

1. Computer as Components by Wayne Wolf published by Elsevier Inc
2. ARM System Developer’s Guide by Andrew S. Loss published by Elsevier Inc
3. Embedded System Design by Steve Heath published by Elsevier Inc
4. Embedded System design: A unified hardware/software Introduction by Frank Vahid & Tony Givagi published by John Wiley & Sons Inc.

2MCS3 Distributed Algorithms

Course No. 2MCS3 **Course Title:** Distributed Algorithms

L-T-P Structure : 3-1-0 **Maximum Marks Theory:** 125

Models of synchronous and asynchronous distributed computing systems: synchronous networks, asynchronous shared memory, asynchronous networks; basic algorithms for synchronous and asynchronous networks: leader election, breadth first search, shortest path, minimum spanning tree; advanced synchronous algorithms: distributed consensus with failures, commit protocols; asynchronous shared memory algorithms: mutual exclusion and consensus; relationship between shared memory and network models; asynchronous networks with failures.

Suggested reference materials:

1. Nancy Lynch, "Distributed Algorithms" Morgan Kaufmann.
2. Gerlad Tel, "Introduction to Distributed Algorithms" Cambridge University Press.

2MCS4.1 Advanced Computer Graphics

Course No.: 2MCS4.1 **Course Title :** Advanced Computer Graphics
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Rendering: Ray tracing, Radiosity methods, Global illumination models, Shadow generation, Mapping, Anti-aliasing, Volume rendering, Geometrical Modeling: Parametric surfaces, Implicit surfaces, Meshes, Animation: spline driven, quaternion, articulated structures (forward and inverse kinematics), deformation -- purely geometric, physically-based.

Suggested reference materials:

1. Alan Watt and Mark Watt: "Advanced Animation and Rendering Techniques, Theory and Practice", Addison Wesley.

2MCS4.2 High Performance Scientific Computing

Course No.: 2MCS4.2 **Course Title :** High Performance Scientific Computing
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Overview of Scientific Computing, Tools-Elements of Mat Lab, Elements of IDL, Elements of AVS, Scientific Visualization Architecture- Computer Performance. Vector Computing. Distributed-memory MIMD Computing. SIMD Computing. Applications-Advection. Computerized Tomography. A review of selected topic from Numerical Analysis.

Suggested texts and reference materials :

1. G.H. Golub,J.M. Ortega"Scientific computing -An introduction With parallel computing" Academic Press,
2. Lloyd D. Fosdick,Elizabeth R. Jessup,Carolyn"an introduction to High Performance Scientific computing" PHI

2MCS4.3 Advanced Real-Time System Design

Course No.: 2MCS4.3 **Course Title :** Advanced Real-Time System Design
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Advance Real-Time Systems: Multiprocessor scheduling, load sharing techniques, performance metric in Real-Time Systems. Resource management and resource reclaiming in uniprocessor and multiprocessor systems. Scheduling flexible computations and tasks with temporal distance constraints. Practical factors and overheads in scheduling, task synchronization, fault tolerance in multi processor systems, Real-Time communication. Introduction to object oriented approaches; case study of distributed Real-Time Systems.

Suggested reference materials:
1. J.W.S. Liu: "Real-Time system", Pearson Education Asia.
2. S.T. Lavi, A.K. Agarwal: "Real-time system Design", McGraw Hill.
3. P.A. Laplante: "Real-time Systems Design and Analysis, An Engineer's Handbook", IEEE Press.
4. P.D. Laurence, K.Mauch: "Real-time Microcomputer system design, An introduction", McGraw Hill.

Semester-III

3MCS1 Parallel & Distributed Computing

Course No.: 3MCS1 **Course Title :** Distributed & Parallel Computing
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Introduction to Parallel and Distributed Systems, goals, hardware concepts, software concepts, client server model; communication, layered protocols, remote procedure call, objective invocation, message & stream oriented communication; processes, threads, clients, servers; naming entities, mobile and unreferenced entities; clock synchronization , algorithms, transaction; consistency and replication, data-centric & client-centric models, protocols; fault tolerance, process resilience, reliable client-server & group Communication, commit, recovery; security ,channels, access, security control; distributed object-based systems explanation and comparison ;distributed file systems (SUN, CODA) and comparison; distributed document-based system and coordination-based systems, multimedia systems, Parallel Programming Languages and Algorithms.

Suggested reference materials:
1. Andrew S. Tanenbaum, marten van steen "Distributed Systems Principals and Paradigms" Pearson Edu.
2. George Coulouris, Jean Dollimore, Tim Kindberg "Distributed Systems Concepts and Design" Pearson Edu.
3. Joel M. Crichlow " An Introduction to Distributed & Parallel Computing" 2nd ed. PHI.
4. M. Sasikumar, Dinesh Shikhare P Ravi Prakash "Introduction to parallel Processing" PHI
5. Andrew S. Tanenbaum "Distributed Operating System"TMH
6. K. H. Wang "Advanced Computer Architecture" TMH.

3MCS2.1 Reconfigurable Computing

Course No.: 3MCS2.1 **Course Title :** Reconfigurable Computing
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Evolution of programmable devices: Introduction to AND-OR structured Programmable Logic Devices PROM, PLA, PAL and MPGAs; Combinational and sequential circuit realization using PROM based Programmable Logic Element (PLE); Architecture of FPAD, FPLA, FPLS and FPID devices.

FPGA Technology: FPGA resources - Logic Blocks and Interconnection Resources; Economics and applications of FPGAs; Implementation Process for FPGAs Programming Technologies - Static RAM Programming, Anti Fuse Programming, EPROM and EEPROM Programming Technology; Commercially available FPGAs - Xilinx FPGAs, Altera FPGAs; FPGA Design Flow Example - Initial

Design Entry, Translation to XNF Format, Partitioning, Place and Route, Performance Calculation and Design Verification.

Technology Mapping for FPGAs: Logic Synthesis - Logic Optimization and Technology Mapping; Lookup Table Technology Mapping - Chortle-crf Technology Mapper, Chortle-d Technology Mapper, Lookup Table Technology Mapping in mis-pga, Lookup Table Technology Mapping in Asyl and Hydra Technology Mapper; Multiplexer Technology Mapping - Multiplexer Technology Mapping in mis-pga.

Logic Block Architecture: Logic Block Functionality versus Area-Efficiency - Logic Block Selection, Experimental Procedure, Logic Block Area and Routing Model and Results.

Routing for FPGAs: Routing Terminology; Strategy for routing in FPGAs; Routing for Row-Based FPGAs - Segmented channel routing, 1-channel routing algorithm, K – channel routing algorithm and results.

Reference:

1. FPGA Based System Design by Wayne Wolf published by Pearson Education

2. Digital System Design Using Programmable Logic Devices by Parag K Lala published by BS publications

3. Field-Programmable Gate Arrays by Stephen Brown published by Kluwer Academic Publishers

3MCS2.2 Artificial Intelligence & Fuzzy Systems

Course No.: 3MCS2.2 **Course Title :** Artificial Intelligence & Fuzzy Systems
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Neuro-Fuzzy and Soft Computing: Introduction to Neuro-Fuzzy and Soft Computing, Fuzzy Set Theory, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Adaptive Neural Networks, Supervised Learning Neural Networks, Learning from Reinforcement, Unsupervised Learning and Other Neural Networks, ANFIS: Adaptive Neuro-Fuzzy Inference Systems, Neuro-Fuzzy Control, ANFIS Applications (Printed Character Recognition, Adaptive Noise Cancellation), Fuzzy Sets and Genetic Algorithms in Game Playing, Soft Computing for Color Recipe Prediction.

Suggested reference materials:

1. J.S.R. Jang, C. – T, Son, E.Mizutani “Neuro-fuzzy and Soft Computing” PHI ,
2. Russel and Norvig: "AI, a modern approach", Pearson Education
3. Rich and Knight: "AI" Tata McGraw Hill
4. KM Fu: "Neural Networks in Computer Intelligence", McGraw Hill

3MCS2.3 NETWORK SYSTEM DESIGN

Course No.: 3MCS2.3 **Course Title :** Artificial Intelligence & Fuzzy Systems
L-T-P Structure: 3-1-0 **Maximum Marks Theory:** 125

Review of Protocols & Packet Format; Network Systems & the Internet, Network Systems Engineering, Packet Processing, Achieving high speed, Network Speed, Hardware, Software & hybrids.

A conventional computer system, Fetch-Store paradigm, Network Interface Card functionality, Onboard address recognition, Packet Buffering, Promiscuous mode.

IP Datagram, Fragmentation, Reassembly, Forwarding, TCP Splicing.

RISC vs. CISC, Network Processors, Ingress & Egress Processing, Parallel & Distributed Architecture, Network Processor Design, Examples of Commercial Network Processors, Overview of Intel Network Processor, Micro engine Programming, Core Programming.

Laboratory work: Build packet analyzer, IP fragmenter, Ethernet bridge, packet forwarding. Project should be assigned to students to build software component using IXP 1200.

References:

1. Network Systems Design using Network Processor, Douglas Comer, Pearson Education, ISBN 81-7808-994-7
2. IXP 1200 programming, Erik J. Johnson and Aaron Kunze, Intel Press.