National Institute of Technology Calicut
B. Tech. Degree Programme in Computer Science & Engineering
Curriculum
(2003 admission Onwards)

First Semester

SI. No	Course Title	Code	Contact hours per week			Credits	Category
			L	G	P		
1	Mathematics I	MA101T	3	1	0	4	BS
2	Physics I	SH101T	3	0	0	3	BS
3	Engineering Mechanics I	ZZ101T	2	1	0	3	ES
4	Engineering Graphics I	ZZ103D	1	0	3	3	TA
5	Chemistry	SH103C	2	0	2	3	BS
6	Professional Communication	SH106T	3	0	0	3	HL
7	Mechanical Engineering Workshop/ Civil Engineering Workshop	ME103L/CE101L	0	0	2	1	TA
8	Ph. Edn.(1Cr.),Value Education (1Cr.) National Service Scheme (1Cr.).	OT	-	-	-	3*	-
	Total	-	14	2	7	23	-

Second Semester

SI. No	Course Title	Code	Contact hours per week			Credits	Category
			L	G	P		
1	Mathematics II	MA102T	3	1	0	4	BS
2	Physics II	SH102C	2	0	2	3	BS
3	Engineering Mechanics II	ZZ102T	2	1	0	3	ES
4	Engineering Graphics II	ZZ104D	1	0	3	3	TA
5	Basic Electrical Engineering	EE101T	2	1	0	3	ES
6	Basic Electronics Engineering	EC101T	2	1	0	3	ES
7	Introduction to computing	CS102T	2	1	0	3	ES
8	Mechanical Engineering Workshop/ Civil Engineering Workshop	ME103L/ CE101L	0	0	2	1	TA
	Total	-	16	6	7	23	-

Third Semester

SI. No	Course Title	Code	Contact hours per week			Credits	Category
			L	G	P		
1	Mathematics III	MA201T	3	1	0	3	
2	Electrical Circuits and Systems	EE217T	3	1	0	3	
3	Electronic Circuits and Systems	EC219T	3	1	0	3	
4	Program Design	CS210T	3	1	0	3	
5	Logic Design	CS211T	3	1	0	3	
6	Data Structures and Algorithms	CS213T	3	1	0	3	
7	Electronics Lab	EC216L	0	0	3	1	
8	Programming Lab	CS217L	0	0	3	1	
	Total	-	18	6	6	20	

Fourth Semester

SI. No	Course Title	Code	Contact hours per week			Credits	Category
			L	G	P		
1	Mathematics IV	MA202T	3	1	0	3	
2	Theory of Computation	CS221T	3	1	0	3	
3	Discrete Computational Structures	CS212T	3	1	0	3	
4	Computer Systems Software	CS223T	3	1	0	3	
5	Computer Hardware Design	CS224T	3	1	0	3	
6	Computer Organization	CS225T	3	1	0	3	
7	Data Structures Lab	CS226L	0	0	3	1	
8	Digital Systems Lab	CS227L	0	0	3	1	
	Total	-	18	6	6	20	

Fifth Semester

SI. No	Course Title	Code	Contact hours per week			Credits	Category
			L	G	P		
1	Software Engineering	CS301T	3	1	0	3	
2	Communication and Information Theory	CS312T	3	1	0	3	
3	Operating Systems	CS313T	3	1	0	3	
4	Principles of Programming Languages	CS314T	3	1	0	3	
5	Computational Combinatorics	CS222T	3	1	0	3	
6	Environmental Studies	ZZ301Z	3	1	0	3	
7	Hardware Lab	CS316L	0	0	3	1	
8	Operating Systems Lab	CS326L	0	0	3	1	
	Total	-	18	6	6	20	

Sixth Semester

SI. No	Course Title	Code	L	G	P	Credits	Category
			Contact hours per week				
1	Principles of Management	ME401T	3	1	0	3	
2	Compiler Construction	CS311T	3	1	0	3	
3	Computer Architecture	CS321T	3	1	0	3	
4	Computer Networks	CS322T	3	1	0	3	
5	Database Management Systems	CS323T	3	1	0	3	
6	Elective		3	1	0	3	
7	Compiler Lab	CS317L	0	0	3	1	
8	Networks & DBMS Lab	CS327L	0	0	3	1	
9	Mini Project/ Industrial Training	CS398P/ CS399P	0 0	0 0	3 3	1** 1**	
	Total	-	18	6	9	21	

Seventh Semester

SI. No	Course Title	Code	L	G	P	Credits	Category
			Contact hours per week				
1	Economics	SH301T	3	1	0	3	
2	Design and Analysis of Algorithms	CS421T	3	1	0	3	
3	Elective		3	1	0	3	
4	Elective		3	1	0	3	
5	Elective		3	1	0	3	
6	Seminar	CS497S	0	0	3	1	
7	Project	CS498P	0	0	3	3	
8	Programming Paradigms Lab	CS416L	0	0	3	1	
	Total	-	18	6	6	20	

Eighth Semester

SI. No	Course Title	Code	L	G	P	Credits	Category
			Contact hours per week				
1	Computational Intelligence	CS422T	3	1	0	3	
2	Elective		3	1	0	3	
3	Elective		3	1	0	3	
4	Elective		3	1	0	3	
5	Elective		3	1	0	3	
6	Project	CS499P	0	0	5	5	
	Total	-	15	5	5	20	

Semester (B.Tech)	Credits
I	23
II	23
III	20
IV	20
V	20
VI	21
VII	20
VIII	20
Total Credits	167

* Three courses of one credit each, to be credited before completing six semesters of the programme.

** One of Mini Project and Industrial Training is compulsory. Candidates are free to credit both.

Electives:

1. CS332T Advanced Data Structures
2. CS333T Object Oriented-Analysis & Design
3. CS334T Web Programming
4. CS431T Advanced Database Management Systems
5. CS432T Multimedia System Design
6. CS341T Distributed Computing
7. CS343T Embedded System Design
8. CS441T Advanced Computer Architecture
9. CS351T Network Security
10. CS352T Coding Theory
11. CS353T Mobile Communication Systems
12. CS354T Electronic Commerce
13. CS356T Mobile Computing
14. CS361T Image Processing
15. CS362T Pattern Recognition
16. CS364T Natural Language Processing
17. CS371T Logic for Computer Science
18. CS372T Number Theory & Cryptography
19. CS373T Computational Complexity
20. CS471T Advanced topics in Algorithms
21. CS472T Quantum Computation
22. CS473T Algorithms for VLSI Design
23. CS331T Computer Graphics & Multimedia Systems

CS102T: INTRODUCTION TO COMPUTING

Prerequisite: Nil

Algorithm discovery and design, analysis of algorithms, Boolean functions and logical operations, Karnaugh map, Quine-McClusky algorithm, computer organization, assemblers and assembly languages, operating systems, object oriented programs, HTML, compilation, Turing machine, databases, computer networks, Internet and WWW, computing security.

References:
1. G. M. Schneider and J. L. Gersting, *An Invitation to Computer Science*, 2/e, Thomson Publishing, 1999.
2. T. L. Floyd, *Digital Fundamentals*, 3/e, Universal Book Stall, New Delhi, 1986.
3. A. W. Bierman, *Great Ideas in Computer Science*, 2/e, MIT Press, 1997

EE217T – ELECTRICAL CIRCUITS & SYSTEMS

Prerequisite: EE101T

Electric Circuit Parameters, Sinusoidal and Steady State Analysis, Lap Lace Transform Analysis of Simple Electric Circuits, Review of Electric Network Theorems, Network Graph Theory, Introduction to Control Systems, Open Loop & Closed Loop Control Systems, Principles of Electromechanical Energy Conversion, Electric Machines, Introduction to Power Supply System, Static Power Supply Devices.

Reference:
Hayt and Kemmerly, *Engineering Circuit Analysis*, McGraw Hill.

EC219T – ELECTRONIC CIRCUITS & SYSTEMS

Prerequisite: EC101T

Bipolar junction Transistor, Biasing, Small signal Amplifiers, Classification of amplifiers, *Field Effect Transistors,* Power Amplifiers, Feedback in Amplifiers, Oscillators, Operational Amplifiers, analog computation, active filters, A/D converters, Multivibrators, Schmitt trigger, Miller & Bootstrap Time base generators, 555 Timer circuits, *Logic families*

Reference:
J. Millman and C. Halkias, *Integrated Electronics: Analog and Digital Circuits and systems*, Tata McGraw Hill, New Delhi, 1972.

CS210T : PROGRAM DESIGN

Prerequisite: Nil

Problem solving, elegance in program design, program testing and documentation, control structures, functions, arrays, pointers and strings, classes and data abstraction, inheritance, virtual functions and polymorphism, input/output, exception handling, file processing, class string and string stream processing.

References:
1. Juliet P., *Program Design*, 4/e, Prentice Hall India, 2000.
2. Dietel H. M. and Deitel P. J., *C++, How to Program*, 3/e, Pearson Education, 2001.

CS211T LOGIC DESIGN

Prerequisite: CS102T

Number Systems and codes, *Boolean algebra, Boolean functions and logical operations*, *Karnaugh map,* Quine-McClusky algorithm, *Combinational Logic,* adders, comparators, decoders and encoders, multiplexers, ROMs, PLAs, *Fault diagnosis and tolerance, programmable logic arrays, c*ounters and shift registers, Clock mode sequential machines

Reference:
N. N. Biswas, *Logic Design Theory*, Prentice Hall of India, New Delhi, 1993.

CS213T – DATA STRUCTURES & ALGORITHMS

Prerequisite: CS102T

Review of data types, Data abstraction, Time and space complexity of algorithms, Recursion, linear data structures: Stacks, queues, lists, Non linear Structures: Graphs, trees, sets, Searching, Sorting, Bubble sort, insertion Sort, selection sort. nlogn sorts, quick sort, heap sort, merge sort. External sort, merge files.

Reference:
Aho A.V., Hopcroft J.E., and Ullman J.D., *Data Structures and Algorithms*, Pearson Education, New Delhi, 1983.

EC216L – ELECTRONICS LAB

Electronics Workshops, diode characteristics, UJT and UJT relaxation oscillator, transistor characteristics, wave shaping circuits, Series voltage regulator, Frequency response of CE amplifier, measurement of input and output impedance, oscillator, Op Amp.

Reference:
J.Millman and C. Halkias, *Integrated Electronics: Analog and Digital Circuits and systems*, Tata McGraw Hill, New Delhi, 1972.

CS217L – PROGRAMMING LAB

Prerequisite: CS102T

HCF (Euclid's algorithm) and LCM of given numbers, Conversion of numbers from binary to decimal, hexadecimal, octal and back, evaluation of functions like e^x, $\sin x$, $\cos x$ etc. for a given numerical precision using Taylor's series, testing whether a given number is prime, string manipulation programs, Matrix operations, Files.

References:
1. H. Schildt, *C: The Complete Reference*, 4/e, Tata McGraw Hill, 2000.
2. T. H. Cormen, C. E. Lieserson, R. L. Rivest, *Introduction to Algorithms*, PHI, 1998

CS221T – THEORY OF COMPUTATION

Prerequisite: CS102T

Basic concepts of Languages, Automata and Grammar, Regular Languages, Kleene's theorem, Pumping Lemma, Context Free Languages, Pushdown Automata. Turing Machines: TM Computations, Church Turing Thesis, Decidability, Redecidability. Computational Complexity: classes P and NP - NP-Completeness - Reductions

Reference:
Michael Sipser, Introduction to the theory of Computation, Thomson Learning, Singapore, 2001

CS212T DISCRETE COMPUTATIONAL STRUCTURES

Prerequisite: Nil

Review of set theory, Logic, laws of logic, rules of inference, relations and Functions, partial ordering, equivalence relations, lattices, Boolean algebra, groups, cyclic groups, Cosets and Lagrange's Theorem, linear codes, Rings, the integer modulo n, polynomial rings, finite fields.

Reference:
Grimaldi R. P., *Discrete and Combinatorial Mathematics*, 4/e, Pearson Education, New Delhi, 1999.

CS223T – COMPUTER SYSTEMS SOFTWARE

Prerequisite: CS213T

System software machine architecture, RISC machines, Assemblers, Assembler design, Loaders and linkers, Macro Processors, Device Drivers, Disk Device Driver Access Strategies, Operating System Overview , Operating System Design Options, Windows 2000 & UNIX overview.

Reference:
L. L. Beck, *System software - An introduction to Systems Programming*, 3/e, Addison-Wesley, 1999.

CS224T – COMPUTER HARDWARE DESIGN

Prerequisite: CS211T

PC hardware, Interfaces, operating system, BIOS, and memory organization. *8086/8088 Hardware specification,* Features of Pentium IV processor, *Microprocessor architecture, Addressing modes, Programming the microprocessor,* using assembly language with C/C++, Memory interface, I/O interface, Interrupts, DMA, Bus interface: ISA bus, EISA and VESA buses, PCI bus.

Reference:
B. B. Brey, *The Intel Microprocessors 8086 to Pentium: Architecture, Programming and Interface*, 6/e, Pearson Education, 2003.

CS225T – COMPUTER ORGANISATION

Prerequisite: CS211T

Computer abstraction and technology, measuring performance, Instructions, Computer arithmetic, constructing an ALU, multiplication and division, floating point representation and arithmetic, processor, Memory hierarchy: caches, virtual memory, Input/output, buses.

Reference:
D. A. Patterson and J. L. Hennessy, *Computer Organisation and Design: The Hardware/ Software Interface*, 2/e, Harcourt Asia Pte Ltd (Morgan Kaufman), Singapore, 1998.

CS226L – DATA STRUCTURES LAB

Stack and Queue, Searching Methods, Sorting, Binary Search Tree, Infix Expression Evaluation, graph Search Algorithm, Minimal Spanning Tree,Shortest Path Algorithm, Disjoint Set operations, Applications of Heap.

CS227L – DIGITAL SYSTEMS LAB

TTL characteristics, Half and full adders, Digital comparator, parity generator, flipflops, Shift register, counter, multivibrator, frequency divider using 555 .

CS301T - SOFTWARE ENGINEERING

Prerequisite: CS213T

Software process, software requirements, requirements engineering processes,system models, Software prototyping , formal specification, architectural design, object-oriented design, Dependability verification and validation, software testing, software, Software project management, software cost estimation, quality, configuration.

References:
1. Ian Sommerville, *Software Engineering*, 6/e, Pearson Education Asia, 2003.
2. Pressman R. S., *Software Engineering*, 5/e, McGraw Hill, 2003

CS312T COMMUNICATION & INFORMATION THEORY

Prerequisite: EC219T

Noise in communication systems, PAM, PPM, PWM, PCM, delta modulation, digital modulation, information theory, channel capacity, Coding Theory, Introduction to convolutional codes.

References:
1. Kolimbiris H., *Digital Communication Systems*, Pearson Education, 2001.
2. Bose R., *Information Theory, coding & Cryptography*, Tata McGraw-Hill, 2002.
3. Taub H. and Schilling D. L, *Principles of Communication Systems*, 2/e, McGrawHill, 1986

CS313T - OPERATING SYSTEMS

Prerequisite: CS223T

Process description and control, Threads, SMP and Microkernels, Deadlock and starvation, Memory management, Virtual memory, Scheduling, Multiprocessor and real-time scheduling, Input-Output, files and Security, File management, Computer Security

References:
1. William Stallings, *Operating systems- Internals and design principles*, 4/e, PHI Pvt. Ltd., New Delhi, 2002.
2. Nutt G.J, *Operating systems- A modern perspective*, Addison Wesley, 1999.

CS 314T PRINCIPLES OF PROGRAMMING LANGUAGES

Prerequisite: CS213T

Syntax and semantics of programming languages. *Imperative programming*: Block structure, Scope rules, Principle of abstraction, Parameter passing mechanisms. *Functional programming:* Functions, Recursion, Types, Data abstraction, Polymorphism, Untyped and simply-typed Lambda calculus and extensions.

References:
1. Sethi R., *Programming Languages: Concepts and Constructs,* 2/e, Addison-Wesley, 1995
2. Benjamin C. Pierce, *Types and Programming Languages*. MIT Press, 2002

CS222T COMPUTATIONAL COMBINATORICS

Prerequisite: CS212T

Counting, permutations, combinations, combinations with repetition. The principle of inclusion and exclusion, derangements, pigeonhole principle. Generating Functions, Recurrence Relations, Graphs, Euler trails and circuits, planar graphs, Hamilton paths and cycles, graph colouring, Polya's Enumeration, Trees, weighted trees. Optimization and Matching, transport networks.

Reference:
Grimaldi R. P., *Discrete and Combinatorial Mathematics*, 5/e, Addison Wesley, 2002.

CS316L – HARDWARE LAB

Identification of components/cards and PC assembling from components, 8086 Assembly language programming (non-recursive and recursive) TSR Prog: Disk I/O, Keyboard - stepper motor – Display – ADC/DAC – Interfacing, Wave form generation.

References:
1. Messmer H. P., *The Indispensable PC Hardware Book*, 3/e, Addison Wesley.
2. Hall D.V., *Microprocessors and Interfacing*, 2/e, Tata McGraw Hill.

CS 326L OPERATING SYSTEMS LAB

Enhance the primitive NACHOS operating Systems with the following capabilities:
1. Load Module -Implementation of Read(), Write(), Open() and Close() system calls.
2. Multiprogramming- Implementation of *Fork, Wait, Exec and Exit,*
3. Translation Lookaside Buffer (TLB)
4. File System
5. Synchronization-Semaphore, Locks and Conditional Variables
6. Networking-Nachos Mailbox

Reference:
Gary J. Nutt, *Operating Systems*, Pearson Education, 3/e, 2004.

CS311T - COMPILER CONSTRUCTION

Prerequisite: CS221T

Phases of a compiler, lexical analysis, lexical analyzer generators, Syntax analysis, Syntax-directed translation, run-time environments, symbol tables, Intermediate code generation, introduction to code optimization, code generation.

References:
1. Aho A.V., Sethi R. & Ullman J.D., *Compilers Principles, Techniques and Tools,* Addison Wesley, 1986.
2. Appel A.W., *Modern Compiler Implementation in Java*, Cambridge University Press, 2/e, 2002.

CS321T: COMPUTER ARCHITECTURE

Prerequisite: CS225T

Performance evaluation, Processor architecture, pipelining, pipeline hazards, issues in pipelined processor implementation. Instruction level parallelism, hardware and compiler support for branch prediction, out-of-order Instruction issue, speculative execution and other techniques for high-performance. Instruction and data cache organizations, multilevel caches, parallel memory systems, Support for virtual memory. Multiple processor systems, Interconnection networks, shared memory system, memory models, cache coherence.

References:
1. Hennesy J. L. & Patterson D. A., *Computer Architecture: A Quantitative approach*, 3/e, Harcourt Asia Pte Ltd. (Morgan Kaufman), Singapore, 2003.
2. Patterson D. A. & Hennesy J. L., *Computer Organisation and Design: The Hardware/ Software Interface*, 2/e, Harcourt Asia Pte Ltd (Morgan Kaufman), Singapore
3. Hwang K., *Advanced Computer Architecture: Parallelism, Scalability and Programmability*, McGraw Hill, Singapore, 1993.

CS322T COMPUTER NETWORKS

Prerequisite: CS312T

Physical layer, Link layer services, error detection and correction, Ethernet, hubs, bridges, switches, wireless links, Transport layer services, UDP and TCP, Network layer services, routing, IP, Internet, Application layer protocols, Network Security, Protocols, Firewalls.

References:
1. Peterson L.L. & Davie B.S., *Computer Networks, A systems approach*, 3/E, Harcourt Asia, 2003.
2. Keshav S., *An Engineering Approach to Computer Networking*, Pearson Education, 2000.
3. Andrew S. Tanenbaum, *Computer Networks*, 3/E, PHI, 1996.

CS323T - DATABASE MANAGEMENT SYSTEMS

Prerequisite: CS213T

Database System Concepts and Architecture, Data Modeling using ER model, Relational data model, Relational algebra and Relational calculus, SQL, Relational database design using ER to relational mapping, Database design theory and Methodology, Data storage, Indexing and physical design, Transaction processing concepts.

References:
1. Elmasri & Navathe, *Fundamentals of Database Systems*, 4rd Edition, Addison Wesley
2. Ramakrishnan R. & Gehrke J., *Database Management Systems*, 2/e, McGraw Hill
3. O'neil P. & O'neil E., *Database Principles, Programming, and Performance*, 2/e, Harcourt Asia, Morgan Kaufman

CS 317L COMPILER LAB

Generation of lexical analyzer using tools such as LEX, Generation of parser using tools such as YACC, Creation of Symbol tables, Creation of type checker, Generation of intermediate code, Generation of machine code.

Reference:
Halub A. I., *Compiler Design in C,* Prentice Hall India

CS 327 L   NETWORKS AND DBMS LAB

Part 1 – Networks

Lab 1- Implementation of PC to PC file transfer using serial port and MODEM. *Lab 2, 3* - Software Simulation of Medium Access Control protocols - 1) Go Back N, 2) Selective Repeat and 3) Sliding Window. *Lab 4* - Implementation of a subset of Simple Mail Transfer Protocol using UDP - *Lab 5, 6* - Implementation of a subset of File Transfer Protocol using TCP/IP. *Lab 7* - Implementation of "finger" utility using Remote Procedure Call (RPC). *Lab 8* - Generation and processing of HTML forms using CGI.

Part 2 – DBMS

Lab 1 - Implementation of B tree and B+ tree . *Lab 2* - Implement a database stored in an RDBMS accessible through a web browser. *Lab 3* - Minibase [Expected time: 3 weeks]
In this part students have to implement a simplified single-user relational database system, called MINIBASE. The MINIBASE project involves writing code for both the logical layer and the physical layer of a Database Management System. Refer the Minibase homepage for more information *(http://www.cs.wisc.edu/coral/minibase/ minibase.html).* The goal is not just to have a functional DBMS, but to have a DBMS where the individual components can be studied and implemented by students.

References:
1. Stevans W. Richard, *Unix Network Programming*, PHI
2. Comer D.E., *Internetworking with TCP/IP*, Vol. 1,2 & 3, PHI
3. Campione et. al M., *The Java Tutorial Continued*, Addison Wesley
4. Douglas E Comer., *Hands-on Networking with Internet Technologies*, Pearson Education
5. Elmasri, Navathe, *Fundamentals of Database Systems*, 4th Edition, Pearson Education

CS398P MINI PROJECT

Each student group (not more than 5 members in a group) is expected to develop a complete software product using software engineering techniques. The product is to be installed and should have user manuals. A detailed report is also to be submitted. The students may be accessed individually and in groups.

CS399P INDUSTRIAL TRAINING

Each student is expected to undertake with help from the Department of Training and Placement, Internship in the field of Computer Science and Engineering by undergoing training of at least one-month duration in reputed industries/research centers in the country. The industrial training is expected to be undertaken during the semester recess. The student should write a final report on this training and should make an oral presentation before an evaluation committee.

CS421T DESIGN AND ANALYSIS OF ALGORITHMS

Prerequisite: CS213T

Space and Time Complexities. Asymptotic notations and complexity classes. Algorithm Design Paradigms: Brute Force, Divide and Conquer, Decrease and Conquer, Transform and Conquer, Dynamic, Greedy. Back Tracking, Branch and Bound, Approximation Algorithms. Space-Time Trade-offs.

References:
1. Anany Levitin, *Introduction to the Design & Analysis of Algorithms*, Pearson Education. 2003
2. Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms*, Second Edition. PHI. 2002.
3. Aho, Hopcroft and Ullman, *The Design and Analysis of Algorithms*, Seventh Indian Reprint, Pearson Education, 2002.

CS331T COMPUTER GRAPHICS & MULTIMEDIA SYSTEMS

Prerequisite: CS213T

Basic raster graphics algorithms for drawing 2D primitives - 2D transformations - Input devices and interactive techniques - 3D graphics - 3D transformations. Introduction to multimedia - multimedia hardware - multimedia software. Multimedia building blocks - audio - images and graphics - animation techniques. Data compression - basic compression techniques like JPEG, H.261, MPEG and DVI - multimedia database systems.

References:
1. Foley J. D., Van Dam A., Feiner S. K., & Hughes J. F., *Computer Graphics Principles and Practice*, Second Edition, Addison Wesley
2. Ralf Steinmetz & Klara Nahrstedt, *Multimedia: Computing, Communications and Applications*, Pearson Education
3. Koegel Buford J. F., *Multimedia System*, Addison Wesley

CS 497S SEMINAR

Each student is expected to present a seminar on a topic of current relevance in computer science and engineering – they have to refer papers from standard journals like ACM, IEEE, JPDC, IEE etc. – at least three cross references must be used – the seminar report must not be the reproduction of the original paper.

CS498P PROJECT

This project is for a duration of two semesters. Each student group(not more than 5 members in a group) is expected to develop a complete product. The design and development may include hardware and /or software. First part of the project is mainly for the design of the product. An interim report is to be submitted at the end of the semester. The assessment may be made individually and in groups.

CS416L PROGRAMMING PARADIGMS LAB

Tower of Hanoi - recursive and non-recursive, Eight Queens Knight's tour Expression Evaluation. These problems are solved in procedural, object oriented, functional and logic paradigms. Specific problems suitable for the above paradigms are also given. A scripting language is also introduced.

CS422T - COMPUTATIONAL INTELLIGENCE

Prerequisite: CS213T

Artificial Intelligence, Structures and Strategies for state space search, Knowledge representation, AI Representational Schemes, Machine Learning, The Genetic algorithm, Genetic Programming, Rule based Expert Systems, Introduction to Natural Language Processing, Languages and Programming Techniques for AI.

References:
1. Luger G. F., *Artificial Intelligence- Structures and Strategies for Complex Problem Solving*, 4/e, Pearson Education
2. Elain Rich & Kevin Knight, *Artificial Intelligence*, 2/e, Tata McGraw Hill
3. Steven. L. Tanimotto, *The Elements of Artificial Intelligence*, Computer Science Press Winston P H, LISP, Addison Wesley

CS499P PROJECT

This is the second part of the project. This part is for the development, testing, and installation of the product. The product should have user manuals. A detailed report is to be submitted at the end of the semester. The assessment may be made individually and in groups.

CS 332T ADVANCED DATA STRUCTURES

Prerequisite: CS213T

A review of elementary data structures. Hash tables - different implementations - collision handling. Binary Search Trees - Red-Black Trees - AVL Trees - optimal binary tree. B-Trees. Binomial and fibonacci heaps. Datastructure for representing disjoint sets.
Data structure choice and justification for some practical Applications.

References:
1. Cormen, Leiserson, Rivest and Stein, *Introduction to algorithms*, Second Edition, PHI, 2002.
2. Niklaus Wirth, *Algorithms + Data structures = Programs*, PHI, 1994

CS 333T OBJECT ORIENTED ANALYSIS AND DESIGN
Structural Modeling – UML Models – Behavioral and Architectural Models – Design Patterns – Object Oriented Testing Methodologies - Components.

References:
1. Page Jones M., *Fundamentals of Object Oriented Design in UML*, Pearson Education, 2000.
2. Booch G., Rumbaugh J. & Jacobsons I., *The Unified Modeling Language User Guide,* Addison Wesley, 2000.
3. Bahrami A., *Object Oriented System Development*, McGraw Hill, 2000.

CS 334T: WEB PROGRAMMING

Prerequisite: CS213T & CS322T

Internet and WWW, HTML, Paintshop, Photoshop, FrontPage, JavaScript/Jscript, Dynamic HTML, multimedia, e-commerce security, web servers, SQL, ADO and RDS, Active server pages, CGI and Perl, XML, Servlets .

References:
1. H. M. Deitel, P. J. Deitel and T. R. Nieto, *Internet and World Wide Web: How To Program*, Pearson Education, 2000.
2. Current Literature

CS431T   ADVANCED DATABASE MANAGEMENT SYSTEMS

Prerequisite: CS323T

Overview of relational database concept - object oriented database - overview of CORBA standard for distributed objects, Distributed database concepts - overview of client - server architecture and its relationship to distributed database, Deductive database - basic inference mechanism for logic programs - data warehousing and data mining - database on World Wide Web - multimedia database - mobile database - geographic information system - digital libraries, Oracle and microsoft access - basic structure of the oracle system, database structures and its manipulation in oracle - programming oracle applications - oracle tools - an overview of microsoft access features and functionality of access - distributed databases in oracle.

References :
1. Elmasri & Navathe, *Fundamentals of Database Systems*, 3/e, Addison Wesley
2. Ramakrishnan R. & Gehrke J., *Database Management Systems*, 2/e, McGraw Hill
3. O'neil P. & O'neil E., *Database Principles, Programming and Performance*, 2/e, Harcourt Asia (Morgan Kaufman)
4. Silberschatz, Korth H. F. & Sudarshan S., *Database System Concepts*, Tata McGraw Hill
5. Theory T. J., *Database Modelling and Design*, 3/e, Harcourt Asia (Morgan Kaufman)

CS432T: MULTIMEDIA SYSTEM DESIGN

Prerequisite: CS213T

Introduction, compression and decompression, data and file format standards, multimedia I/O technologies, storage and retrieval technologies, architectural and telecommunications considerations, multimedia application design, multimedia authoring and user interface, hypermedia messaging, distributed multimedia systems.

References:
1. P. K. Andleigh and K. Thakrar, *Multimedia System Design, ,* Prentice Hall India, 1996.
2. Current Literature.

CS341T: DISTRIBUTED COMPUTING

Prerequisite: CS313T

Operating system fundamentals - distributed system concepts and architectures - major design issues - distributed computing environments (DCE)
Concurrent processes and programming - threads and processes - client server model - time services - language mechanisms for synchronization - concurrent programming languages
Interprocess communication and coordination - message passing communication - request/reply communication - transaction communication - name and directory services - distributed mutual exclusion - leader election
Distributed process scheduling - static process scheduling, dynamic load sharing and balancing - distributed process implementation - real-time scheduling - concepts of distributed file systems - distributed shared memory - distributed computer security

References:
1. Chow R. & Johnson T., *Distributed Operating Systems and Algorithms*, Addison Wesley
2. Sinha P. K., *Distributed Operating Systems Concepts and Design*, PHI
3. Tanenbaum S., *Distributed Operating Systems*, Pearson Education.
4. Coulouris G., Dollimore J. & Kindberg T., *Distributed Systems Concepts And Design*, 2/e, Addison Wesley
5. Singhal M. & Shivaratri, *Advanced Concepts in Operating Systems, Distributed Databases And Multiprocessor Operating Systems*, McGraw Hill

CS 343T   EMBEDDED SYSTEM DESIGN

Prerequisite: CS313T, CS224T & CS301

Embedded system overview, trends in embedded software development, applications of embedded systems, hardware architecture, software engineering practices in the embedded software development process, embedded software development environments, embedded OS, development tools for target processors, real-time embedded software, embedded communication, mobile and database applications.

References:
1. DreamTech Software Team, *Programming of Embedded Systems*, Wiley DreamTech, 2002.
2. R. Kamal, *Embedded Systems: Architecture, Programming and Design*, Tata McGraw Hill, 2003.
3. F. Vahid and T. Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, John Wiley, 2002.

CS 441T ADVANCED COMPUTER ARCHITECTURE

Prerequisite: CS321T

Advanced ILP Exploitation Techniques – Super speculative and VLIW Processors – Simulators – ADLs, Traces and Dynamic Compilation – Multithreaded Processors. Case studies.

References:
1. Hennessy J. L., D. Patterson, *Computer Architecture – A quantitative Approach*, Morgan Kauffman (3/e), 2001.
2. Current Literature.

CS 351T   NETWORK SECURITY

Prerequisite: CS322T

Security and Attacks – Cryptography & Cryptanalysis, – Program Security –S/MIME, SSL, S/WAN, IPSCC, SSH, Kerberos, Security Products - Viruses and methods of protection – Authentication – Models of Security – Security issues in OS, DBMS and Networks – Legal and ethical issues.

References:
1. C. P. Fleeger and S. L. Fleeger, *Security in Computing*, 3/e, Pearson Education, 2003.
2. Stallings W., *Cryptography and Network Security Principles and Practice*, 3/e, Pearson Education Asia, 2003.
3. Stallings W., *Network Security Essentials: Applications and Standards*, Pearson Education Asia, 2002
4. Current literature

CS352T CODING THEORY

Prerequisite: CS312T

Linear Codes – Syndrome decoding – Error bounds – Distance properties – ML Decoding.
Review of Groups, Rings and fields – Construction of GF (Pn) – Cyclic codes and ideals – BCH and Read Solomn Codes – decoding circuits.
Convolutional code representation Schemes – Maximum Likely hood decoding – Viterbi and Sequential decoding.
APP – Decoding – Introduction to Iterative (Turbo) Codes – List decoding.

References:
1. R.J. McEliece, *The Theory of Information and Coding*, Addison Wesley, 1997.
2. R. Johannesson, K. Sh. Zigangirov, *Fundamentals of Convolutional Coding*, Universities Press, 2001.

CS 353T: MOBILE COMMUNICATION SYSTEMS

Prerequisite: CS322T

Introduction, reference model wireless transmission - frequencies for radio transmission, CSMA, GSM, broadcast systems, Wireless LAN, IEEE 802.1, HIPERLAN – bluetooth, Mobile network layer, mobile transport layer, WAP, WM, wireless telephony application

References:
1. Schiller J., *Mobile Communications*, 2/e, Addison Wesley, 2003
2. Singhal et.al S., *The Wireless Application Protocol*, Addison Wesley

CS 354T: ELECTRONIC COMMERCE

Prerequisite: CS213T & 322T

Web commerce concepts, electronic marketplace technologies, security issues, approaches to safe e-commerce, Electronic payment systems, electronic cash, electronic wallets, smart cards, strategies for marketing, sales on the web, supply chain management, strategies for web auctions, legal - ethical and tax issues.

References:
1. Kalakota R. & Whinston A.B., *Frontiers of Electronic Commerce*, Addison-Wesley, New Delhi, 1999.
2. Schneider G. P. & Perry J. T., *Electronic Commerce, Course Technology*, Cambridge

CS 356T: MOBILE COMPUTING

Prerequisite: CS322T & 313T

Pervasive computing, entertainment systems, operating systems for mobile computing, client middleware, security, wireless and mobile internet, Protocols, Mobile Applications.

References:
1. U. Hansmann, L. Merk, M. S. Nicklous and T. Stober, *Principles of Mobile Computing*, 2/e, Springer, 2003.
2. J. Schiller, *Mobile Communications*, 2/e, Pearson education, 2003.
3. Current Literature.

CS 361T IMAGE PROCESSING

Introduction - digital image representation, fundamental steps in image processing. *Image transforms:* Introduction to Fourier transform, discrete Fourier transform. *Image enhancement:* point processing, spatial filtering. Image compression, image compression models. *Image reconstruction from projections*

References:
1. Rafael C., Gonzalez & Richard E. Woods, *Digital Image Processing*, Addison Wesley, Delhi
2. Rosenfeld A. & Kak A.C., *Digital Picture Processing*, Academic Press
3. Jain A.K, *Fundamentals of Digital Image Processing*,Prentice Hall, Englewood Cliffs, N.J.
4. Schalkoff R. J., *Digital Image Processing and Computer Vision*, John Wiley and Sons, NY.
5. Pratt W.K., *Digital Image Processing*, 2nd edition, John Wiley and Sons, New York

CS 362T PATTERN RECOGNITION

Introduction- Introduction to statistical, syntactic and descriptive approaches. *Parameter estimation and supervised learning, Nonparametric technic*- density estimation, parzen windows, k-nearest Neighbour estimation, *Linear discriminant functions, Syntactic approach to PR*- Introduction to pattern grammars and languages.

References:
1. Duda R.O, Hart P.E and Stork D.G, *Pattern Classification*, 2/e, John Wiley and Sons Inc., NY, 2001.
2. Gonzalez R.C. and Thomson M.G., *Syntactic Pattern Recognition – an Introduction*, Addison Wesley, 1997

CS 364T NATURAL LANGUAGE PROCESSING

Prerequisite: CS221T

Introduction to Natural Language Understanding, Different levels of Language Analysis, Representations and Understanding, Linguistic Background, Grammars and Parsing, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Grammars for Natural Language, Movement Phenomenon in Language, Hold mechanisms in ATNs, Human preferences in Parsing, Encoding uncertainty, Ambiguity Resolution: Statistical Methods, Part-of-Speech tagging, Probabilistic Context-Free Grammars, Best First Parsing.

References:
1. James Allen, *Natural Language Understanding*, 2/e, Pearson Education, 2003
2. D. Jurafsky, J.H. Martin, *Speech and Language Processing*, Pearson Education, 2002
3. L.M. Ivansca, S.C. Shapiro, *Natural Language Processing and Language Representation*

CS371T LOGIC FOR COMPUTER SCIENCE

Prerequisite: CS212T

Propositional Logic, First-order Logic, completeness theorem, Undecidability in Logic, Godels incompleteness theorem, Second-order Logic, Review of complexity classes P, NP. Logical characterizations

References:
1. Gallier, J. H., *Logic for Computer Science: Foundations of Automatic Theorem Proving*, Harper and Row, 1986.
2. Papadimitriou, C. H., *Computational Complexity*, Addison Wesley, 1994

CS 372T: NUMBER THEORY & CRYPTOGRAPHY

Prerequisite: CS212T

Divisiblity,   fundamental theorem of arithmetic, congruence, Fermat's theorem, Euler function, Indeterminate equations, Chinese remainder theorem, quadratic residues – Zero knowledge systems, Cryptography, DES, IDEA, AES, key distribution , Public key encryption, RSA algorithm, elliptic curve cryptography , message authentication, digital signatures.

References:
1. Niven, Zuckerman & Moutgomerry, *An introduction to The Theory of Numbers*, 3/e, John Wiley and Sons, New York, 2003
2. Stallings W., *Cryptography and Network Security Principles and Practice*, 2/e, Pearson Education Asia.

CS373T COMPUTATIONAL COMPLEXITY

Prerequisite: CS221T

Automata Theory   Myhill-Nerode Theorem, Pumping Lemma. Turing Machines Computability Undecidability – Reductions – Rice Theorem. Introduction to Complexity Time and Space complexity classes,   Machine Independent Complexity Theory   NP Completeness, Cook's Theorem.

References:
1. Sipser M. *Introduction to the Theory of Computation*, PWS Publishing Company, 1997
2. Papadimitriou C.H., *Computational Complexity*, Addison Wesley, 1994
3. Hopcroft J.E. and Ullman J.D., *Introduction to Automata Theory, Languages and Computation*, Addison Wesley, 1979

CS471T ADVANCED TOPICS IN ALGORITHMS

Prerequisite: CS421T

Discrete Probability: Probability, Expectations, Tail Bounds, Chernoff Bound, Markov Chains. *Randomized Algorithms:* Finger Printing, Pattern Matching, Graph Problems, Algebraic Methods, Probabilistic Primality Testing, De-Randomization. *Complexity:* Probabilistic Complexity Classes, Probabilistic Proof Theory and Certificates, Interactive and Zero Knowledge Proof Systems, Arthur Merlin Games. *Kolmogorv Complexity:* Definition of Randomness, Unsolvability results, Chatin's Proof for Godel's Theorem.

References:
1. R. Motwani and P. Raghavan, *Randomized Algorithms*, Cambrdige University Press, 1995
2. C. H. Papadimitriou, *Computational Complexity*, Addison Wesley, 1994
3. Dexter C. Kozen, *The Design and Analysis of Algorithms*, Springer verlag N.Y, 1992

CS 472T QUANTUM COMPUTATION

Theory of Finite Dimensional Hilbert Spaces and Tensor Products – Models for Quantum Computation – Quantum Algorithms – Grover's and Shor's Algorithms – Quantum Complexity Classes – Introduction to Quantum Coding Theory.

References:
1. Nielsen M.A. and I.L. Chauang, *Quantum Computation and Quantum Information*, Cambridge University Press, 2002.
2. Gruska, J. *Quantum Computing*, McGraw Hill, 1999.
3. Halmos, P. R. *Finite Dimensional Vector Spaces*, Van Nostrand, 1958.

CS 473T: ALGORITHMS FOR VLSI DESIGN

Prerequisite: CS213T

VLSI physical design automation, design and fabrication of VLSI devices, algorithms, partitioning, placement, floor planning and pin assignment, global routing, detailed routing, via minimization and over the cell routing, specialized routing, compaction.

References:
1. N. A. Sherwani, *Algorithms for VLSI Physical Design Automation*, Third Edition, Kluwer Academic, 1998.
2. Current Literature.
Wesley, 1998