SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01CS6102	Parallel Computer Architecture	3-1-0	40	60	3	4
B	01CS6104	Operating System Design	3-0-0	40	60	3	3
C	01CS6106	Advanced Computer Networks	3-0-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
V	01CS6192	Mini Project	0-0-4	100			2
U	01CS6194	Network & OS Laboratory	0-0-2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

01CS6152 Parallel Algorithms
01CS6154 Soft Computing
01CS6156 Computational Geometry
01CS6158 Semantic Web Technology
01CS6162 Advanced Complier Design

Elective III

01CS6172 Machine Learning
01CS6174 Advanced Graph Theory
01CS6176 Cyber Laws & Ethics
01CS6178 Principles of Information Security

SEMSTER 2

SYLLABUS & COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6102	Parallel Computer Architecture	3-1-0	4	2015

Course Objectives

1. To understand issues and techniques in improving performance of processors
2. To understand the concepts of pipelining
3. To familiarize with the properties of superscalar processors
4. To understand the multiprocessor systems and the concept of cache coherence

Syllabus

Classes of parallelism and parallel architecture, computer architecture- design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism -concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP.
Dynamic Scheduling- Tomasulo's approach, Hardware based speculation, ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation, case study- Intel Core i7. Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes , Graphic processing units. Multiprocessor system interconnects-hierarchical bus system, Cross bar switch and multiport memory, multistage networks, Centralized shared memory architecture, Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations, Distributed shared memory and Directory based coherence.

Expected Outcome

In-depth knowledge in

1. Measuring performance of processors
2. Instruction level parallelism
3. Vector Architecture
4. Multiprocessor systems and cache coherence.
5. Interconnection networks

References

1. Hennessy J. L., D. Patterson, "Computer Architecture – A quantitative Approach", 5/e, Morgan Kauffman 2012.
2. DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures – A Design Space Approach", Pearson Education India, 2009.
3. Kai Hwang, "Advanced Computer Architecture Parallelism, Scalability, Programmability", Tata McGraw-Hill, 2003.
4. John Paul Shen, MikkoLipasti, "Modern Processor Design – Fundamentals of Superscalar Processors", McGraw-Hill International Edition, 2005.
5. WWW Computer Architecture page. http://www.cs.wisc.edu/arch.

01CS6102 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Classes of parallelism and parallel architecture, computer architecture - design issues.	5	15
	Performance measurements, quantitative principles of computer design, Instruction level parallelism -concepts and challenges.	6	
II	Data dependencies and hazards, Basic compiler techniques for exposing instruction-level parallelism.	7	15
FIRST INTERNAL EXAM			
III	Dynamic Scheduling- Tomasulo's approach, Hardware based speculation.	5	15
	ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation.	5	
IV	Case study- Intel Core i7.	5	15
	Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes , Graphic processing units.	5	
SECOND INTERNAL EXAM			
V	Multiprocessor system interconnects - hierarchical bus system, Cross bar switch and multiport memory.	6	20
	Multistage networks. Centralized shared memory architecture.	4	
VI	Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations.	4	20
	Distributed shared memory and Directory based coherence.	**4**	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6104	Operating System Design	3-0-0	3	2015

Course Objectives

1. To understand the configuration and functions of a typical OS Kernel
2. To have an overview on concepts implemented in modern operating systems.

Syllabus

Process Management, Process Scheduling, Real-Time Scheduling Policies. System Calls, Interrupts and Interrupt Handlers, Kernel Synchronization, Kernel Synchronization Methods, Timers and Time Management - Memory Management, Virtual Filesystem, I/O Schedulers
Distributed Operating System, strategies for ordering events in a distributed system. Issues with distributed mutual exclusion-Solutions, Heuristic.Deadlock Handling strategies

Expected Outcome

1. In-depth knowledge in Design and implementation of Kernel modules.
2. An understanding on how the basic concepts are modified to cater changing architectural features.

References

1. Robert Love, "Linux Kernel Development", 3/e, Addison-Wesley, 2010.
2. Advanced Concepts in Operating Systems – Singhal
3. Daniel Bovet, Marco Cesati, "Understanding the Linux Kernel", 3/e, OReilly Media Inc., 2005.
4. Operating Systems Concepts, 9th Edition- Silberschatz, Galvin, Gagne
5. Linux Kernel Architecture – Wolfgang Mauerer.
6. Reilly Christian Benvenuti, "Understanding Linux Network Internals", 1/e, OReilly Media Inc.,2005.
7. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, "Linux Device Drivers", 3/e, OReilly Media Inc., 2005.

0CS6104 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction - Process Management - Process Descriptor and the Task Structure, Process Creation, The Linux Implementation of Threads, Process Termination. Process Scheduling - Policy, Linux Scheduling Algorithm and Implementation, Preemption and Context Switching, Real-Time Scheduling Policies. System Calls - Communicating with the Kernel, Syscalls, System Call Handler, System Call Implementation, and System Call Context. * Linux commands like ps, pmap may be used to understand how the address space changes during process creation and thread creation.	6	15
II	Interrupts and Interrupt Handlers - Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Interrupt Control, Bottom Halves – Task Queues, Softirqs, Tasklets, Work Queues *(Students are not expected to memorize the system calls used/ structure formats of the different constructs used in implementing Bottom Halves. The main highlight should be to understand the way in which the different constructs are used)* * Students may be encouraged to implement their own interrupt handler in a custom compiled kernel.	6	15
FIRST INTERNAL EXAM			
III	Kernel Synchronization – Introduction, Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability *(Self Study – These topics are already covered in undergraduate classes)***.** Kernel Synchronization Methods - Atomic Integer and Atomic Bitwise Operations (Concepts only), Spin Locks - Types, Semaphores – Types, Mutexes, Completion Variables, BKL: The Big Kernel Lock, Sequential Locks, Preemption Disabling.	7	20
IV	Timers and Time Management - Kernel Notion of Time, Jiffies, Hardware Clocks and Timers, Using Timers, Delaying Execution. Memory Management - Pages and Zones, functionality of kmalloc(), kfree(), vmalloc(). Slab Layer – Design, Per-CPU Allocations. The Virtual File system – VFS objects, data structures their relationship and functionalities.	7	15
SECOND INTERNAL EXAM			
V	The Block I/O Layer - Request Queues, I/O Schedulers – Types, Scheduler Selection. Portability – Issues related to Word size and Data types, Data Alignment, Byte Order, Time, Processor Ordering.	7	15
VI	Distributed processing – client/ server and clusters. Distributed process management - process migration, distributed global states, distributed mutual exclusion, distributed deadlock.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6106	Advanced Computer Networks	3-0-0	3	2015

Course Objectives

1. To impart a deeper understanding of protocols, quality of service and congestion management, wireless transmission and compression.
2. To analyze the issues of transmitting real time data.
3. To identify the technologies that can transmit data efficiently.

Syllabus

Network Architecture - Internet Protocol - Packet switching- Cell switching -Routers – TCP protocol – UDP protocol - Congestion Management - Wireless Transmission – Routing - Quality of Service - Peer to Peer Networks -Content Distribution Networks - Virtual Private Networks and tunnels - Multimedia Networking - Streaming Stored Audio and Video, Protocol for Real time Application – Text, Image, Audio and Video Compression Techniques.

Expected Outcome

Deeper understanding of existing techniques for developing new technologies for transmitting data in real time without congestion.

References

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks – A systems Approach", Elsevier, Fourth Edition, 2008.
2. Andrews S. Tanenbaum, "Computer Networks", Fourth Edition, Pearson Education, 2003.
3. Natalia Olifer Victor Olifer, "Computer Networks - Principles, Technologies and Protocols for Network Design", - Wiley India(P) Ltd. 2006.
4. William Stallings, "High Speed Networks and Internets – Performance and Quality of Service", Pearson Education, 2005.
5. James F. Kurose and Keith W. Ross ,"Computer Networking- A Top Down Approach Featuring Internet", Pearson Education, 2006.
6. Fred Hallsall, Lingana Gouda Kulkarni, "Computer Networking and the internet" Fifth Edition", Pearson Education, 2007.
7. Fred Hallsall, "Multimedia Communications – Applications, Networks, Protocols and Standards", Pearson Education, 2012.

01CS6106 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Network Architecture: Reference models of OSI, TCP/IP, ATM. Protocol implementation issues. Physical address, Logical address.	3	15
	Internet Protocol: Packet Format (IPV4 and IPV6), Features of IPv6, CIDR notation, Subnetting, Supernetting, DHCP.	4	
II	Packet switching: Datagrams, Virtual circuit switching, Fragmentation of IP packets. Cell switching in ATM, Internetworking devices: Repeaters, Hubs, Bridges, LAN switches, Routers and Gateway.	4	15
	Routers: Router functions, Classification of routers, Features of IP Routers, Filtering, Network Address Translation (NAT).	3	
FIRST INTERNAL EXAM			
III	TCP Protocol: Services, protocol operation, TCP connection establishment and termination, Nagle's algorithm, Silly Window Syndrome, TCP timer Management, Karn's algorithm. UDP protocol : services and protocol operation.	3	15
	Congestion Management: Congestion control in Data Networks and Internets, Random Early Detection (RED). TCP congestion control: Additive increase/Multiplicative decrease, Slow start, Fast retransmit and Fast recovery.	3	
IV	Wireless Transmission : Wireless systems, Bluetooth architecture and protocol stack, Wireless Ad-hoc networks, Overview of generations of cell phone technologies.	4	15
	Routing: Static and Dynamic routing, Internetworking routing, Border Gateway Protocol (BGP), Routing in Ad-hoc networks.	3	
SECOND INTERNAL EXAM			
V	Quality of Service: Requirements and parameters of Quality of Service, Integrated Services, Resource Reservation Protocol (RSVP), Differentiated Services.	3	20
	Peer to Peer Networks: Gnutella, BitTorrent. Node Lookup in Peer to Peer Networks, Content Distribution Networks. Virtual Private Networks and tunnels.	4	
VI	Multimedia Networking: Streaming Stored Audio and Video, Real time Streaming Protocol (RTSP), Real Time Transport Protocol (RTP).	3	20
	Compression: Text compression – LZ and LZW coding, Huffman coding, JPEG image compression, Adaptive differential pulse code modulation (ADPCM), MPEG Audio Coders, Principles of Video Compression, MPEG1, MPEG2 and MPEG4 standards.	5	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6152	Parallel Algorithms	3-0-0	3	2015

Course Objectives

1. To understand the principles and applications of parallel algorithms.
2. To learn parallel algorithms for SIMD and MIMD computers.
3. To learn a large class of commonly used algorithms in parallel environment and their complexity analysis.

Syllabus

Need of parallel computers, Expressing algorithms, tree and Mesh interconnection super computers, sorting **,** Matrix Transposition, Matrix operations – matrix-by-matrix multiplications – mesh multiplications – cube multiplication, Matrix by vector multiplication, Linear array and tree multiplications, Solving numerical problems, solving partial differential equations, computing Eigen values.

Expected Outcome

1. Students gain in-depth theoretical and practical knowledge on parallel algorithms.

References

1. S.G.Akl, "Design and Analysis of parallel algorithms", PrenticeHall, Inc. 1989.
2. S.G.Akl, "Parallel Sorting algorithm", Academic Press, 1985.
3. M.J.Quin, "Parallel computing – theory and Practice", McGrawHill, New York, 1994.
4. S. Lakshmivarahan and S.K.Dhall, "Analysis and design of Parallel Algorithms – Arithmetic & Matrix problems", McGrawHill, New York, 1990.
5. B. Wilkinson, M. Allen, "Parallel Programming", 2/e, Pearson Education Inc, 2007.
6. M .J. Quin, "Parallel Programming in C with MPI and openMP", Tata McGraw Hill, 2007.

01CS6152 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Need of parallel computers – Models of computation – Analyzing algorithms – Expressing algorithms – Broadcast – All sums and selection algorithms on SIMD, Searching a sorted sequence – EREW, CREW SMSIMD algorithms, Searching a random sequence – SMSIMD – tree and Mesh interconnection super computers.	9	20
II	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.	6	15
FIRST INTERNAL EXAM			
III	Matrix Transposition – Mesh transpose – shuffle transpose – EREW transpose, Matrix operations – matrix-by-matrix multiplications – mesh multiplications – cube multiplication.	7	15
IV	Matrix by vector multiplication, Linear array multiplication – tree multiplications, Solving numerical problems – solving systems of linear equations – SIMD algorithms and MIMD algorithms.	7	15
SECOND INTERNAL EXAM			
V	Numerical problems – finding roots of nonlinear equations – SIMD and MIMD algorithms, solving partial differential equations, computing eigen values.	7	20
VI	Graph theoretical problems – computing connectivity matrix – finding connected components – all pairs shortest path – traversing combinatorial spaces – sequential tree traversals.	6	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6154	Soft Computing	3-0-0	3	2015

Course Objectives

1. To familiarize the salient approaches in soft computing, based on artificial neural networks, fuzzy logic, and genetic algorithms
2. To introduce applications of soft computing in different research areas in Computer Science / Information Technology

Syllabus

Artificial Neural Network, Typical architectures, Different learning methods, Common activation functions, Models Of Neural Network, Fuzzy Sets & Logic, Defuzzification methods, Genetic Algorithm, Evolutionary Computation, Genetic Programming Schema theorem; Multi-objective & Multimodal optimization in GA; Applications, Hybrid Systems

Expected Outcome

1. Understand basic concepts in artificial neural networks, fuzzy logic, and genetic algorithm
2. Able to apply soft computing techniques to research problems

References

1. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", 2/e, John Wiley India, 2012.
2. S. Haykin, "Neural Networks - A Comprehensive Foundation", 2/e, Pearson Education, 2005.
3. T.S. Rajasekaran, G.A. VijaylakshmiPai, "Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis and Applications", Prentice-Hall India, 2003.
4. Sanchez, Takanori, Zadeh, "Genetic Algorithm and Fuzzy Logic System", World Scientific, 1997.
5. Goldberg David, "Genetic Algorithms", Pearson Education, 2006.
6. Zimmermann H. J, "Fuzzy Set Theory & Its Applications", Allied Publishers Ltd, 1991.

01CS6154 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Artificial Neural Network, Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model.	3	15
	Properties of neural networks, Typical architectures: single layer, multilayer, competitive layer;	3	
II	Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent neural networks; Application of neural networks; Neuron.	6	15
FIRST INTERNAL EXAM			
III	Models Of Neural Network : Architecture, Algorithm & Application of – McCullo h-Pitts.	4	15
	Back propagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet.	3	
IV	Fuzzy Sets & Logic : Fuzzy versus Crisp; Fuzzy sets—membership function, linguistic variable, basic operators, properties; Fuzzy relations—Cartesian product, Operations on relations;	4	15
	Crisp logic—Laws of propositional logic, Inference; Predicate logic—Interpretations, Inference; Fuzzy logic—Quantifiers, Inference; Defuzzification methods.	3	
SECOND INTERNAL EXAM			
V	Genetic Algorithm Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation.	4	20
VI	Applications: Travelling Salesman Problem, Graph Coloring problem.	4	20
	Hybrid Systems : GA based BPNN(Weight determination); Neuro Fuzzy Systems—Fuzzy BPNN--fuzzy Neuron, architecture, learning; Fuzzy Logic controlled G.A.	4	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6156	Computational Geometry	3-0-0	3	2015

Course Objectives

1. To fill the gap between geometric properties and algorithm design
2. To familiarize data structures used for developing efficient algorithms
3. To learn efficient techniques for solving geometric problems

Syllabus

Geometric Preliminaries, Data Structures for geometric problems, Geometric Searching, applications, Range Searching using Kd-trees, Convex Hulls, Triangulatio, Voronoi Diagrams, Delaunay Triangulation, Introduction to Visibility Problems, Visibility graph

Expected Outcome

4. Capable to develop efficient algorithms by exploiting geometric properties
5. Capable in identifying properties of objects, expressing them as lemmas and theorems and proving their correctness.
6. Capable in applying learned algorithm in diversified fields like data base
7. Searching, data mining, graphics, image processing pattern recognition,
8. computer vision motion planning and robotics

References

1. Franco P. Preparata, Michael Ian Shamos, "Computational Geometry- An Introduction", Texts and Monographs in Computer Science , Springer – Verlag
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars " Computational Geometry, Algorithms & Applications" Springer
3. Herbert Edelsbrunner, "Algorithms in Combinatorial Geometry", EATCS Monographs on Theoretical Computer Science, Springer – Verlag.
4. Art Gallery Theorems, Joseph O' Rourke, Oxford Press.
5. Joseph O' Rourke, " Computational Geometry in C", Cambridge University Press

01CS6156 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Geometric Preliminaries, Data Structures for geometric problems : DCEL (Doubly Connected Edge List), Quad trees, Kd-trees and BSP (Binary Space Partition) trees.	5	15
II	Geometric Searching - Planar Straight Line Graph (PSLG), Point Location Problem, Location of a point in a planar subdivision, Plane Sweep Technique-applications- line segment inter section using plane sweep ,Slab method, Regularization of PSLG, Monotone polygons , Range Searching using Kd-trees	9	25
FIRST INTERNAL EXAM			
III	Convex Hulls, Convex Hull Algorithms in the Plane -- Graham's Scan Algorithm, Jarvi's March, Divide and Conquer Algorithm, Quick Hull Algorithm. Triangulation— Polygon Triangulation	8	20
IV	Art Gallery Theorem, Fisk's proof of Art Gallery theorem. Post Office Problem - Voronoi Diagrams- Properties , computing Voronoi diagram, Applications in the plane , Delaunay Triangulation	8	20
SECOND INTERNAL EXAM			
V	Introduction to Visibility Problems-- Definition of direct visibility, Point visibility and Edge visibility, Algorithm for computing point-visible region inside a polygon	7	15
VI	Kernel of a simple polygon , Linear time algorithm for computing Kernel. Visibility graph, Shortest path for a point Robot	5	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6158	Semantic Web Technology	3-0-0	3	2015

Course Objectives

1. To understand the principles, practices and applications of Semantic Web Technology.

Syllabus

Introduction to Semantic Web, RDF and RDF schema, SPARQL, Web Ontology Language, formal semantics, Description logic, automated reasoning, ontology rules and queries, ontology engineering, software tools and applications.

Expected Outcome

1. Ability to use the technologies related Semantic Web
2. Ability to express and process domains using ontology and associated tools.

References

1. Liyang Yu, Introduction to the Semantic Web and Semantic Web Services, Chapman & hall/CRC, 2007.
2. Pascal Hitzler, MarkusKrötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & hall/CRC, 2010.
3. Peter Szeredi, GergelyLukacsy, TamasBenko, Zsolt Nagy, The Semantic Web Explained The Technology and Mathematics behind Web 3.0, Cambridge University Press, 2014.
4. Dean Allemang, James Hendler, "Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL", Morgan Kaufmann, 2008.
5. David Wood, Marsha Zaidman, Luke Ruth, Michael Hausenblas, Linked Data, Manning Publication Company, 2014.
6. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez "Ontological Engineering: with examples from the areas of Knowledge Management, e- Commerce and the Semantic Web", Springer, 2009.
7. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", The MIT Press, 2009
8. http://www.w3.org/wiki/SemanticWebTools
9. http://protege.stanford.edu/
10. https://jena.apache.org/

01CS6158 – COURSE PLAN			
Module	***Contents***	***Hours Allotted***	***% of Marks in End-Semester Examination***
I	Introduction to Semantic Web and semantic web technologies (Reading: L. Yu [Ch.1, 2], P. Szeredi [Ch.1], P.Hitzler [Ch. 1])–XML review, First order Logic (review) (Reading: P. Hitzler(Appendix 1, 2])	4	10
II	RDF: overview, elements of RDF, basic syntax, advanced features – Relationship between doubling core, XML and RDF (Reading: L. Yu [Ch.3], P.Hitzler [Ch. 2])	8	20
FIRST INTERNAL EXAM			
III	RDF schema, syntax and semantics, examples. (Reading: L. Yu [Ch.4], P.Hitzler [Ch. 3]) Web ontology language (OWL): Syntax an semantics, reasoning power (informal treatment only), flavours of OWL, OWL2 standard. (Reading: L. Yu [Ch.5], P. Hitzler [Ch. 4]. Additional Reading: P. Szeredi [Ch.8])	10	20
IV	Formal semantics: description Logic, model theoretic semantics of OWL, automated reasoning. (Reading: P. Hitzler [Ch. 5]. Additional Reading: P. Szeredi [Ch.4])	10	20
SECOND INTERNAL EXAM			
V	Ontology Rules and Queries: combining OWL and DL, SPARQL, Query examples,conjuctive queries (Reading: P. Hitzler [Ch. 6,7]). Ontology Engineering: Requirement Analysis, Ontology creation, quality assurance, Modular ontology.	6	20
VI	Software tools: protégé, Jena (Reading: P. Hitzler [Ch. 8.4] and www links (see references)]).Applications (Reading: P. Hitzler [Ch. 9]. Additional Reading: D. Wood [Ch. 6], L. Yu [Ch.9, 10])	4	10
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6162	Advanced Compiler Design	3-0-0	3	2015

Course Objectives

1. To make aware the importance of code optimization in compiler design.
2. To learn various intermediate representations.
3. To understand various data flow analyses and optimization techniques.
4. To learn register allocation technique.
5. To learn machine code generation techniques.
6. To understand back end design of compilers.

Syllabus

Control Flow Analysis, Data Flow Analysis, Dependence analysis & Dependence graphs, Alias analysis, Global Optimizations, Redundancy Elimination, Loop Optimizations, procedure Optimization techniques, Machine Dependent tasks, Low Level Optimization techniques, Introduction to inter-procedural analysis and optimization, Introduction to Affine Transform Theory.

Expected Outcome

1. Conceptual understanding of theory behind compiler design.
2. Ability to build a complete compiler.

References

1. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kauffmann, 1997.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 2009.
3. Andrew W. Appel, "Modern Compiler Implementation in Java", Cambridge University Press, 2009.
4. Keith D. Cooper, Linda Torczon, "Engineering a Compiler", 2/e, Morgan Kauffmann, 2011.

01CS6162 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Review of compiler phases, Informal Compiler Algorithm Notation(ICAN), Symbol Table Structure – local and global symbol tables, Intermediate Representations – HIR – MIR and LIR, Run Time Issues.	5	15
II	Control Flow Analysis – basic blocks – DFS – dominators and postdominators – loops – dominator tree, Data Flow Analysis – reaching definitions – available expressions, – live variable information, Dependence analysis & Dependence graphs, Alias analysis.	9	15
FIRST INTERNAL EXAM			
III	Global Optimizations – constant folding – algebraic simplification and reassociation– constant and copy propagation – dead code elimination, Redundancy Elimination – common subexpression elimination – loop invariant code motion – partial redundancy elimination – code hoisting, Value numbering.	8	20
IV	Loop Optimizations – strength reduction and induction variable elimination, Procedure Optimization techniques, Static Single Assignment(SSA) form – dominance frontier – pi-functions – variable renaming.	8	15
SECOND INTERNAL EXAM			
V	Machine Dependent tasks: Register Allocation – graph coloring – coalescing, Code Scheduling – Instruction Scheduling – Speculative Scheduling – Software pipelining.	5	15
VI	Low Level Optimization techniques, Introduction to inter-procedural analysis and optimization, Machine code generation, Optimizing for Parallelism and Locality – Introduction to Affine Transform Theory.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6172	Machine Learning	3-0-0	3	2015

Course Objectives

1. To understand formulation of machine learning problems corresponding to different applications
2. To impart deeper understanding of concepts of machine learning, attributes, selection, reduction techniques, performance measurements
3. To understand a range of machine learning algorithms for classification, clustering, association rule formation along with their strengths and weaknesses

Syllabus

Introduction to Learning, Attributes, Selection, Reduction techniques, Classification using ANN, Bayes Classifier, Metrics for evaluating classifier performance, Association Rules- Apriori, FP Growth, Eclat, Hidden Markov Models, Algorithms, Self organizing Maps, Support Vector Machines, Unsupervised learning, K-Means algorithm, Hierarchical Clustering Algorithms

Expected Outcome

1. The ability apply preprocessing of data by attribute selection, reduction techniques
2. The ability to apply different machine learning methods for practical applications

References

5. Stephan Marsland, Machine Learning : An Algorithmic Perspective, CRC Press, 2009
6. Jiawei Han, MichelineKamber, Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, 2012
7. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson 2014
8. Tomm. Mitchell, Machine Learning , McGraw Hill Education (India) Pvt Ltd, 2015
9. Vinod Chandra S S , AnandHareendran, Artificial Intelligence and Machine Learning, PHI learning Pvt Ltd, 2014

01CS6172 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to learning, types of learning, role of learning, Machine learning, supervised learning, unsupervised learning, semi-supervised learning, Applications of machine learning	2	15
	Types of data, attributes, types- nominal, ordinal, interval, ratio, Measuring the central tendency-Mean, Median, Mode, Measuring the dispersion of data- Range, Quartiles, Variance, Standard Deviation, Measuring Data Similarity and Dissimilarity between nominal, binary, ordinal attributes, Euclidian, Manhattan distance, Cosine similarity.	3	
II	Chi-square test, Correlation Coefficient for Numeric data, Dimensionality reduction techniques- Principal Component Analysis, Attribute Subset Selection, Parametric data reduction, Histograms	3	15
	Classification- Concepts, Decision trees, Information Gain, Gain Ratio, Gini Index, ID3 Algorithm, C 4.5 algorithm,	3	
FIRST INTERNAL EXAM			
III	Bayes Theorem, Naive Bayesian Classification, Metrics for evaluating Classifier performance- Accuracy, Error rate, Precision, Recall	3	15
	Artificial Neural Networks- basics, learning perception model, Multi layer feed forward network, back propagation	4	
IV	Association Learning, Basics of Association, Apriori Algorithm, Eclat Algorithm, FP Growth Algorithm.	4	15
	Stochastic Process, Markov Process, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Baum-Welch Algorithm	4	
SECOND INTERNAL EXAM			
V	Support Vector Machines- Maximum margin hyperplanes, Linear SVM, Non-linear SVM, Kernel Trick	4	20
	Inductive Logic Programming, Case Based Reasoning, CBR Issues, Ensemble Methods –Bagging, Boosting, AdaBoost, Random Forests,	4	
VI	Unsupervised learning- Clustering – Partitioning Method-K-Means, K-Medoids, Hierarchical Methods- Agglomerative versus Divisive clustering, Single link algorithm, Complete link algorithm, Distance measures in algorithmic methods, BIRCH- Multiphase Hierarchical	4	20

01CS6172 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
	clustering using clustering feature trees. Reinforcement learning,		
	Expectation Maximization(EM), EM Algorithm, Self Organizing Maps, Learning Process of SOM, Important ART Networks, Art Architecture, ART Algorithms	4	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6174	Advanced Graph Theory	3-0-0	3	2015

Course Objectives

1. To impart deeper understanding in advanced concepts in graph theory and their practical applications.

Graphs, Connectivity and Hamiltonicity, Connectivity, The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths- Other Generalized Centers, Extremal Distance Problems, Distance sequences, Matrices, Symmetry, Digraphs, Graph Algorithms, Critical Path Method

Expected Outcome

2. Students become aware of the advanced concepts of graph theory and gain ability to apply those concepts in practical scenarios.

References

1. Fred Buckley and Frank Harary , "Distance in Graphs", Addison – Wesley, 1990.
2. C. R. Flouds: "Graph Theory Applications", Narosa Publishing House, 1994.
3. Harary F: "Graph Theory", Addison- Weslwy pub. 1972.
4. Deo N: "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall Inc. 1974.

01CS6174 – COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Graphs, Connectivity and Hamiltonicity: Graphs: Graphs as models- Paths and connectedness-Cutnodes and Blocks- Graph classes and graph operations. Connectivity: Connectivity and edge connectivity - Menger's theorem - Properties of n-connected graphs-Circulants	8	15
II	Hamiltonicity: Necessary or sufficient conditions- Connectivity and Hamiltonicity- Graph operations and Hamiltonicity - Generations of Hamiltonicity. Centers: The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths- Other Generalized Centers	8	15

01CS6174 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
FIRST INTERNAL EXAM			
III	Extremal Distance Problems: Radius- Small Diameter- Diameter- Long paths and Long Cycles. Distance sequences: The Eccentric Sequence - Distance Sequences - Distribution - Path Sequence - Other Sequences.	8	15
IV	Matrices: The Adjacency Matrix - The incidence Matrix - The Distance Matrix. Convexity: Closure Invariants-Metrics on Graphs - Geodetic Graphs- Distance Heredity Graphs. Symmetry: Groups- Symmetric Graphs - Distance Symmetry	8	20
SECOND INTERNAL EXAM			
V	Digraphs: Digraphs and connectedness - Acyclic Digraphs - Matrices and Eulerian Digraphs- Long paths in Digraphs- Tournaments. Graph Algorithms: Polynomial Algorithms and NP completeness - Path Algorithms and Spanning Trees	6	20
VI	Centers - Maximum Matchings - Two NP-Complete Problems. Networks: The Max- Flow Min-Cut Theorem - Minimum Spanning Trees - Traveling Salesman Problem - Shortest Paths - Centers - Critical Path Method.	4	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6176	Cyber laws and Ethics	3-0-0	3	2015

Course Objectives

1. To impart sufficient knowledge on the fundamental principles of IPR and computer contracts.
2. To understand the different types of cyber crimes and cyber laws in India and abroad.
3. To expose to ethical issues in today's computer based environment.

Syllabus

Intellectual Property Rights, Computer contracts and licences, Computer crimes - different forms, Cyber law in India, IT Act 2000, Offences under IT Act., Protection of IPR in Cyber space in India, International cyber laws and crimes, Ethical issues in computer security.

Expected Outcome

1. Awareness of the different forms of IPR's and related rules and regulations, and of the laws applicable to computer and software related contracts.
2. Exposure to different forms of Cyber crimes and the Indian and International laws to combat Cyber crimes and facilitate e-commerce.
3. Capability to reason out different situations of ethics faced in the cyber world.

References

1. D. Bainbridge, Introduction to Information Technology Law, 6/e, Pearson Education, 2007.
2. Harish Chander, Cyber Laws and IT Protection, PHI Learning Private Limited, 2012.
3. P. Duggal, Cyber law: the Indian Perspective, Saakshar Law Publications, Delhi, 2005.
4. C. P. Fleeger and S. L. Fleeger, Security in Computing, 3/e, Pearson Education, 2003.

01CS6176 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Intellectual property rights, computer software copyrights, copyright in databases and electronic publishing, trade secrets, patent laws, trademarks, industrial designs, international implications of IPR	6	15
II	Computer contracts, liability for defective hardware and software, Contract for writing software, Licence agreements, Website development contracts, Electronic contracts and torts, Liability of ISP's.	5	15
FIRST INTERNAL EXAM			
III	Computer crime, computer frauds, hacking, unauthorized modification of information, piracy, cyber harassment. cyberstalking, cyber defamation. Domain names and cybersquatting.	7	15
IV	Cyber law in India, IT Act 2000- Objectives, Provisions under IT Act, Authentication of electronic records, Digital signature	7	15
SECOND INTERNAL EXAM			
V	Offences under the IT Act 2000: sections 65 to 74, Case studies, Positive aspects and grey areas of the IT Act.	5	20
	Protection of IPR in Cyber space in India: copyright, patents; IPR's needing protection.	3	
VI	International organizations to regulate e-commerce and cyber crimes, COE convention on cyber crimes.	3	20
	Ethical issues in computer security, Case studies.	6	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6178	Principles of Information Security	3-0-0	3	2015

Course Objectives

1. To understand the founding principles of Information security
2. Understand various vulnerability possibility
3. Familiarize with Network security

Syllabus

Security Models, Access control mechanisms, Intellectual property rights, Basics of Copy right, Software vulnerabilities, Malwares, Cryptography Topics: C Attacks, Message Authentication , Digital signature, Discrete Logarithmic protocols , Diffie Hellman Key exchange, El-Gamal encryption, Biometric Authentication

Expected Outcome

1. Conceptual understanding of the principles of information security, its significance and the domain specific security issues.
2. Gather in depth knowledge in vulnerability possibilities
3. Understand the relevance of security in various domains

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References

1. Bernard Menezes, "Network security and Cryptography", Cengage Learning India, 2010.
2. Behrouz A. Forouzan, "Cryptography and Network Security", Special Indian Edition, Tata McGraw Hill, 2007
3. William Stallings, "Cryptography and Network Security: Principles and Practice", 6/e Pearson Education, 2013.
4. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker, "Digital Watermarking and Steganography", 2/e, Morgan Kaufmann, 2008.
5. Dieter Gollmann. "Computer Security", John Wiley and Sons Ltd., 2006.
6. Whitman and Mattord, "Principles of Information Security", Cengage Learning, 2006.
7. D. Bainbridge, "Introduction to Computer Law", 5/e, Pearson Education, 2004.
8. C. Kaufman, R. Perlman and M. Speciner, "Network Security: Private Communication in a public World", 2/e, Prentice Hall, 2002.
9. W. Mao, "Modern Cryptography: Theory & Practice", Pearson Education, 2004.
10. H. Delfs and H. Knebl, "Introduction to Cryptography: Principles and Applications", Springer Verlag, 2002.

01CS6178 – **COURSE PLAN**			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Security Models as basis for OS security, Access Control in OS-Discretionary Access control, Mandatory Access control and Role-based access control, Introduction to DB Security	4	7
	Laws and ethics, Intellectual property rights - Copy right law, Patent law, Copy right basics and Implications of software copy right law	2	
II	Software vulnerabilities- Phishing, Buffer and stack overflow, Heap overflow. Mobile Malware, Viruses, Worms and Trojans	4	11
	Internet scanning worms, Worm Propagation models, Topological worms- E-mail worms, P2P worms.	3	
FIRST INTERNAL EXAM			
III	Cryptography Topics: Cryptographic hash- SHA1, Collision resistance, Birthday attack, Message Authentication code,	4	8
	Digital signature, Discrete Logarithm- Diffie Hellman Key exchange-Protocol, Attacks	4	
IV	*El-Gamal encryption- Signature Scheme, One way and Mutual* authentication, Dictionary attack	4	15
	Needham Schroeder protocol, Kerberos basics, Biometrics for authentication.	3	
SECOND INTERNAL EXAM			
V	Network security topics: Network layer security – IPSec – overview, IP and IPv6, IPSec Protocols: AH and ESP, Tunnel Mode and trasport mode. Internet Key exchange Protocol- IPSec cookies.	8	20
VI	Transport layer security -SSL, SSL Record Layer Protocol. DoS and DDos attacks-SYN flooding, DDoS Attack Detection and prevention, Session Hijacking and ARP spoofing, firewalls- Types, Practical issues, RFID and E-passport, electronic payment, web services security.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6192	Mini Project	0-0-4	2	2015

Course Objectives

To make students

Design and develop a system or application in the area of their specialization.

Approach

The student shall present two seminars and submit a report. The first seminar shall highlight the topic, objectives, methodology, design and expected results. The second seminar is the presentation of the work/ hardware implementation.

Expected Outcome

Upon successful completion of the mini project, the student should be able to

1. Identify and solve various problems associated with designing and implementing a system or application.
2. Test the designed system or application.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6194	Network & OS Laboratory	0-0-2	1	2015

Syllabus

Experiments are based on but not limited to topics covered in *01CS6104: Operating Design* and*01CS6106: Advanced Computer Networks*.

01CS6194 - Experiments	
Experiment No	**Description**
I	Implementation of producer-consumer problem, without using threads.
II	Implementation of dining philosopher problem, without using threads.
III	Development of a new device driver in Linux.
IV	Implementation of web proxy server with filtering and caching
V	Linux kernel configuration, compilation and rebooting from the newly compiled kernel
VI	Implementation of web proxy server with filtering and caching
VII	Implementation of DNS server(defined in RFC 1034 and RFC 1035)
VIII	Implementation of a web (HTTP/1.1) server(HTTP defined in RFC 2616), supporting multiple simultaneous clients or multiple connections from the same client. The server must print all requests it receives to a log file, along with the headers of responses it sends.
IX	Implementation of reliable file transfer over UDP
X	Study and use of packet tracer software(eg. WireShark)
XI	Study and use of protocol analyzer
XII	Study of protocol simulation in NS3 Single Flow TCP experiment using NS3
XIII	Multiple Flow TCP experiment using NS3

01CS6194 - Experiments	
Experiment No	**Description**
XIV	Varying the RTT experiment using NS3
XV	Study of Software-defined networking (SDN)

SEMSTER 3

SYLLABUS & COURSE PLAN