M. Tech. (Computer Engineering) Curriculum Structure
(w. e. f. 2015-16)

List of Abbreviations

ILE- Institute level Elective Course
PSMC – Program Specific Mathematics Course
PCC- Program Core Course
DEC- Department Elective Course
LLC- Liberal Learning (Self learning) Course
MLC- Mandatory Learning Course (Non-credit course)
LC- Laboratory Cours

Semester I

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	ILE	Data Structures [To be offered to other programs]	3	--	--	3
2.	PSMC	Probability, Statistics and Queuing Theory	3	--	--	3
3.	PCC	Topics in Databases (TDB)	3	--	--	3
4.	PCC	Advanced Computer Networks (ACN)	3	--	--	3
5.	PCC	Advanced Computer Architecture (ACA)	3	--	--	3
6.	DEC	Elective – I a. Distributed Operating Systems (DOS) b. Graphics and Visualization (GV) c. Linux Kernel Programming (LKP)	3	--	--	3
7.	LC	PG Laboratory - I	--	--	4	2
8.	MLC	Research Methodology	1	--	--	--
9.	MLC	Humanities	1	--	--	--
		Total	**20**	**0**	6	**20**

Semester II

Sr. No.	Course Code/Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	PCC	Advanced Algorithms (AA)	3	--	--	3
2.	PCC	Security in Computing (SIC)	3	--	--	3
3.	PCC	Data Mining and Machine Learning (DM & ML)	3	--	--	3
4.	DEC	**Elective – II** a. Advanced Graph Theory (AGT) b. Cloud, Virtualization and Big Data (CVB) c. Business Analytics (BA)	3	--	--	3
5.	DEC	**Elective – III** a. Embedded Systems (ES) b. Bioinformatics (BI) c. Advanced Compiler Construction (ACC)	3	--	--	3
6.	SLC	MOOC (Massive Open Online Course)	3	--	--	2
7.	LC	PG Laboratory - II	--	--	4	2
8.	MLC	Intellectual Property Rights	1	--	--	--
9.	LLC	Liberal Learning Course	--	--	--	1
		Total	**19**	**0**	**4**	**20**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase – I	--	--	--	14
		Total	**--**	**--**	**--**	**14**

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase - II	--	--	--	20
		Total	**--**	**--**	**--**	**20**

SEMESTER - I

(ILE) Data Structures

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the advanced data structures such as multi-way trees, balanced trees, heaps, priority queues,
2. Implement above listed advanced data structures to solve computational problems
3. Analyze the time and space complexity of advanced data structures and their supported operations
4. Compare the time and space tradeoff of different advanced data structures and their common operations
5. Use of these data structures in solving real life problems

Syllabus Contents:

- Unit 1 (6 Hrs)

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

- Unit 2 (8 Hrs)

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

- Unit 3 (6 Hrs)

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

- Unit 4 (6 Hrs)

  Data Structures for Partition ADT: Weighted union and path compression, Applications to finite state automata minimization, Code optimization

- Unit 5 (6 Hrs)

  Graph Algorithms: DFS, BFS, Biconnected components, Cut vertices, Matching, Network flow; Maximum-Flow / Minimum-Cut; Ford–Fulkerson algorithm, Augmenting Path

- Unit 6 (8 Hrs)

  Computational Geometry: Geometric data structures, Plane sweep paradigm, Concurrency, Java Threads, Critical Section Problem, Race Conditions, Re-entrant code, Synchronization; Multiple Readers/Writers Problem

Text Books:

1. Introduction to Algorithms; 3rd Edition; by by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein; Published by PHI Learning Pvt. Ltd. ;

ISBN-13: 978-0262033848 ISBN-10: 0262033844

2. Algorithms; 4th Edition; by Robert Sedgewick and Kevin Wayne; Pearson Education, ISBN-13: 978-0321573513

References:

1. Algorithms; by S. Dasgupta, C.H. Papadimitriou, and U. V. Vazirani; Published by Mcgraw-Hill, 2006; ISBN-13: 978-0073523408 ISBN-10: 0073523402

2. Algorithm Design; by J. Kleinberg and E. Tardos; Published by Addison-Wesley, 2006; ISBN-13: 978-0321295354 ISBN-10: 0321295358

(PSMC) Probability, Statistics and Queuing Theory

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. This course will provide necessary understanding in probability, statistics and queuing theory
2. Solve various problems on probability, statistics and queuing theory
3. Analyze the given probabilistic model of the problem
4. Use the techniques studied in probability, statistics and queuing theory to solve problems in domains such as data mining, machine learning, network analysis

Syllabus Contents:

- Unit 1: Basic Probability Theory (2 Hrs)

  Probability axioms, conditional probability, independence of events, Bayes' rule, Bernoulli trials

- Unit 2: Random Variables and Expectation (10 Hrs)
  - Discrete random variables: Random variables and their event spaces, Probability Mass Function, Discrete Distributions such as Binomial, Poisson, Geometric etc., Indicator random variables
  - Continuous random variables: Distributions such as Exponential, Erlang, Gamma, Normal etc., Functions of a random variable
  - Expectation: Moments, Expectation based on multiple random variables,

Transform methods, Moments and Transforms of some distributions such as Binomial, Geometric, Poisson, Gamma, Normal

- Unit 3: Stochastic Processes (4 Hrs)

  Introduction and classification of stochastic processes, Bernoulli process, Poisson process, Renewal processes

- Unit 4: Markov chains (8 Hrs)
  - Discrete-Time Markov chains: computation of n-step transition probabilities, state classification and limiting probabilities, distribution of time between time changes, M/G/1 queuing system
  - Continuous-Time Markov chains: Birth-Death process (M/M/1 and M/M/m queues), Non-birth-death processes, Petri nets

- Unit 5: Statistical Inference (6 Hrs)
  - Parameter Estimation – sampling from normal distribution, exponential distribution, estimation related to Markov chains
  - Hypothesis testing

- Unit 6: Regression and Analysis of Variance (6 Hrs)

  Least square curve fitting, Linear and non-linear regression, Analysis of variance

Text Books:

1. Kishor Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley and Sons, New York, 2001, ISBN number 0-471-33341-7

References:

1. Ronald Walpole, Probability and Statistics for Engineers and Scientists, Pearson, ISBN-13: 978-0321629111

Topics in Databases

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand foundation of the RDBMS theory, internal functioning of a typical RDBMS
2. Design algorithms for various relational operators such as join, groupby etc
3. Implement the algorithms for various relational operators
4. Compare the performance of different algorithms related one relational operator
5. Analyze and understand the latest trends of RDBMS
6. Apply the learnt concepts to decide optimal solutions for real life scenarios

Syllabus Contents:

- Unit 1: Transaction Processing (10 hrs)

  Serial and Serializable Schedules, Conflict-Serializability, Enforcing Serializability by Locks (Two-Phase Locking), Locking Systems With Several Lock Mode, Concurrency Control by Timestamps, Serializability and Recoverability, The Dirty-Data Problem, Cascading Rollback, Recoverable Schedules, Managing Rollbacks Using Locking, Logical Logging, Recovery From Logical Logs, ARIES (Algorithm for Recovery and Isolation Exploiting Semantics), which supports partial rollbacks of transactions, fine granularity (e. g., record) locking and recovery using write-ahead logging (WAL)

- Unit 2: Query Processing (10 hrs)

  Architecture of Query Execution Engines, Disk Access, Aggregation and Duplicate Removal, Sorting and Hashing, Binary Matching Operations (Join Algorithms), Execution of complex query plans, Mechanism for parallel query execution, Non standard query processing algorithms: Nested Relations; Temporal and Scientific Database Management; Object Oriented DBMS, Additional Techniques for performance improvement: Precomputation and Derived data; Data Compression; Surrogate Processing; Bit vector filtering; Specialized Hardware, Query Evaluation Techniques for Large Databases

- Unit 3: Query Optimization (10 hrs)

  Basic Optimization Strategies, Algebraic Manipulation, Optimizations of Selections in System R

- Unit 4: Case Studies: (10 hrs)

  Hadoop Distributed File System: Study of Hadoop Distributed File System. HadoopP is a distributed file system that provides high-throughput access to application data; HIVE - Data warehousing application built on top of Hadoop; MapReduce - It is a patented software framework introduced by Google in 2004 to support distributed computing on large data sets on clusters of computers; Dynamo – It is a highly available, proprietary key-value structured storage system or a distributed data store; Eventual Consistency Model for Distributed Systems

References:

1. J. D. Ullman, Database System:The Complete Book, Pearson, 1st Edition, 2003.
2. C. Mohan, ARIES: A Transaction Recovery Method Supporting Fine-Granularity Locking and Partial Rollbacks Using Write-Ahead Logging, ACM Transactions on Database Systems, Vol. 17, No. 1, March, 1992, pp. 94–162.
3. P. Selinger, M. Astrahan, D. Chamberlin, Raymond Lorie and T. Price. Access Path Selection in a Relational Database Management System, Proceedings of ACM SIGMOD, pp 23-34, 1979
4. http://hadoop.apache.org
5. Jeffrey Dean and Sanjay Ghemawat, MapReduce: Simplified Data Processing on Large Clusters, Communications of the ACM, vol. 51, no. 1, pp. 107-113, 2008
6. Fay Chang, Jeffrey Dean, Sanjay Ghemawat, Wilson C. Hsieh, Deborah A. Wallach, Mike Burrows, Tushar Chandra, Andrew Fikes, and Robert E. Gruber, Bigtable: A Distributed Storage System for Structured Data , Proceedings of Operating Systems Design and Implementation , pp. 205-218, 2006.
7. W. Vogels. Eventually Consistent. ACM Queue, vol. 6, no. 6, December 2008
8. Goetz Graefe, Query Evaluation Techniques for Large Databases, ACM Computing Surveys, Vol. 25, No. 2, June 1993
9. R. Elmasri, and S. Navathe, Fundamentals of Database Systems, Benjamin Cummings, Pearson, 6th Edition, 2010
10. Korth , Silberschatz and Sudarshan, Database System Concepts, Tata McGraw Hill,

6th Edition, 2011.

Advanced Computer Networks

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand issues in the design of network processors and design network systems
2. Analyze different possible solutions for communications at each network layer
3. Simulate working of wired and wireless networks to understand networking concepts
4. Develop solutions by applying knowledge of mathematics, probability, and statistics to network design problems
5. Understand and Compare various storage and networking technologies

Syllabus Contents:

- Unit 1: Internetworking

  Routing Algorithms, Congestion Control, Quality of Service, Queue Management, High Speed Networks, Performance Modeling and Estimation

- Unit 2: IPv6

  IPv4 deficiencies, patching work done with IPv4, IPv6 addressing, multicast, Anycast, ICMPv6, Neighbour discovery, Routing

- Unit 3: Software Defined Networking and OpenFlow

  Centralized and Distributed Control and Data Planes, SDN Controllers, Data Center Concepts, Network Function Virtualization, Mininet, Programming SDNs, Openflow Switch, Wire Protocol, Openstack Neutron plug-in

- Unit 4: Ad Hoc Wireless Networks

MAC Protocols for Ad Hoc Wireless Networks, Routing Protocols for Ad Hoc Wireless Networks, Multicast routing in Ad Hoc Wireless Networks, Transport Layer and Security Protocols for Ad Hoc Wireless Networks, Quality of Service in Ad Hoc Wireless Networks.

- Unit 5: Network management Protocols

  SNMPv1 Network Management: Organization and Information Models, SNMPv2: major changes, SNMPv3, RMON, Network Management Tools, Systems, and Engineering, Network Management Applications

- Unit 6: Storage and Networking

  Storage and Networking Concepts, Fiber Channel Internals, Fiber Channel SAN Topologies, Fiber Channel Products, IP SAN Technology, IP SAN Products, Management of SANs, SAN Issues

References:

1. Thomas D NAdeau and Ken Grey, Software Defined Networking, O'Reilly, 2013
2. Pete Loshin IPv6, Theory, Protocols and Practiice, Morgan Kaufmann, 2nd Edition, 2004
3. Mani Subramanian, Timothy A. Gonsalves,N. Usha Rani; Network Management: Principles and Practice; Pearson Education India, 2010
4. William Stallings, High-Speed Networks and Internets, Pearson Education, 2nd Edition, 2002.
5. C. Siva Ram Murthy, B.S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall, 2004
6. Muthukumaran B, Introduction to High Performance Networks, Tata Mc Graw Hill, 2008
7. Tom Clark, Designing Storage Area Networks, A Practical Reference for ImplementingFibre Channel and IP SANs, Addison-Wesley Professional, 2nd Edition, 2003.

Advanced Computer Architecture

Teaching Scheme **Examination Scheme**

Lectures: 3 hrs/week T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the history , evolution , classifications & current trends of Computer Architecture; Learn to evaluate & compare System's performance using standard benchmarks
2. Understand the basics of advanced Microprocessor techniques & the salient features of state-of-the- art processors deployed in current High Performance Computing systems
3. Understand the differences between System Area Networks & Storage Area Networks & learn the current Networking Technologies for implementing them
4. Learn the advanced RAID Levels, compare SAS vs SATA Disks & understand the implementation of a hierarchical Storage System
5. Understand the System Software Architecture, various parallel programming models, message passing paradigms & typical HPCC software stack
6. Understand, through the case studies of a few selected representative systems, the implementation of architectural concepts learnt through CO-1 to CO-5

Syllabus Contents:

- Unit 1: System Architecture (8 Hrs)

  History /Evolution, Definition: Hardware /Software Architecture, Flynn's Classification: SISD,SIMD,MISD,MIMD. Physical Models: PVP, MPP, SMP& Cluster Of Workstations (COW). Memory Architectures: Shared, Distributed & Hybrid. UMA, NUMA, CC-NUMA. Performance Metrics & Benchmarks (Micro/Macro) Architectural Trends based on TOP 500 List of Supercomputers.

- Unit 2: Advanced Microprocessor Techniques (8 Hrs)

  CISC, RISC, EPIC, Superscalar, Superpipelined Architectures, Superscalar/ Superpipelined, In Order Execution /Out of Order Execution (OOO), ILP, TLP, Power Wall, Moore's Law Redefined, Multicore Technologies, Intel's Tick-Talk Model. Study of State-of-the- ART Processors : Intel / AMD X86-64 Bit Series, (Xeon Haswell & Broadwell Architectures) Intel Xeon Phi Coprocessors (MIC Architecture) Intel/IBM Itanium/Power Series (Power 4 - Power 8). Introduction to Graphics Processing Units (GPU-NVIDIA)

- Unit 3: System Interconnects (4 Hrs)

SAN : System Area Networks, Storage Area Networks including InfiniBand ,Gigabit Ethernet, Scalable Coherent Interface (SCI) Standard

- Unit 4: Storage (4 Hrs)

  Internal/External , Disk Storage, Areal Density ,Seek Time ,Disk Power, Advanced RAID Levels, SATA vs SAS Disks ,Network Attached Storage (NAS) ,Direct Attached Storage (DAS), I/O Performance Benchmarks.

- Unit 5: Software Architecture (8 Hrs)

  Parallel Programming Models: Message Passing ,Data Parallel , MPI/PVM .Typical HPCC Software Stack including Cluster Monitoring Tools, Public Domain Software like GANGLIA, CUDA Programming Environment

- Unit 6: Case Studies (8 Hrs)

  A typical Peta Scale System based on Hybrid CPU/GPU Architectures, IBM SP System, C-DAC's latest PARAM Systems [PARAM Yuva-II] , Sequent NUMA Q

References:

1. John L. Hennesy and David Patterson, Computer Architecture : A Quantitative Approach, 5th Edition, Elsevier
2. Kai Hwang and Zhiwei Xu, Scalable Parallel Computers, McGraw- Hill, 1998.
3. Data Manuals of respective Processors available at Website

(DE) Distributed Operating Systems

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand characteristics & challenges of distributed systems and design issues in distributed operating systems.

2. Study various communication techniques such as message passing mechanism, remote procedure call mechanism and distributed shared memory mechanism used for exchange of information among processes of distributed computing system

3. Analyze the synchronization issues in a distributed system such as clock

synchronization, mutual exclusion, deadlock & election algorithms and approaches for resource management in a distributed system.

4. Familiarity with issues in process management particularly process migration, distributed file system , HDFS architecture, Concept of Virtualization

Syllabus Contents:

- Unit 1: Fundamentals and Message Passing (10 Hrs)

  Fundamentals: Characteristics and challenges of distributed systems. Design issues in distributed operating systems; Architectural models. Message passing: Desirable features of good message passing systems, Issues in IPC by message passing; Synchronization, Buffering, Multi-datagram Messages, Encoding and decoding of message data, process Addressing, Failure Handling, Group Communication

- Unit 2: Remote procedure Call (7 Hrs)

  RPC Model, Transparency of RPC, Implementing RPC mechanisms, RPC messages, Server management, parameter -passing semantics, call semantics Communication protocols for RPC, Client-Server Binding, RPC in Heterogeneous Environment

- Unit 3: Distributed Shared Memory (7 Hrs)

  General Architecture of DSM Systems, Design and Implementation issues in DSM, Consistency Models, Implementing Sequential Consistency Model, page based distributed shared memory, shared –variable distributed shared memory, object-based distributed shared memory. Replacement Strategy, Thrashing, Heterogeneous DSM

- Unit 4 : Synchronization: (5Hrs)

  Clock Synchronization, Event Ordering, Mutual, Exclusion, Deadlock, Election Algorithms

- Unit 5: Resource and Process management (6 Hrs)

  Desirable features of good global scheduling algorithms, Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach, Process management: Process Migration, Threads

- Unit 6 : Distributed File System and Naming (6 Hrs)

  File-Accessing Models, File-Sharing Semantics, File-caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Naming: Fundamental Terminologies and Concepts, System-Oriented names, Object-Locating Mechanisms, Human-Oriented names, Name cache, HDFS architecture and Virtualization concept

References:

1. Sinha P. K., Distributed Operating Systems Concepts and Design, PHI, 1997
2. Tanenbaum A. S., Distributed Operating Systems, Pearson Education India, 1995

(DE) Graphics and Visualization

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Demonstrate the process of generating virtual images from virtual scenes, typically identified as a pipeline of generate, compute and store/display
2. Recognize the potential and benefits of computer graphics and be able to apply it within different fields
3. Understand the different aspects of modeling and animating virtual environments
4. Gain familiarity with the elements of 3D visualization and good sketching technique
5. Get hands-on experience with solid modeling and visualization
6. Ability to select among models for lighting/shading: Color, ambient light; distant and light with sources

Syllabus Contents:

- Unit 1: Foundations of 2D Graphics (6 Hrs)

  Analytic Geometry (i.e., Graphics Primitives), Rasterization, Transformations

- Unit 2: Foundations of 3D Graphics (6 Hrs)

  Analytic Geometry, Transformations, Projections, Hidden surfaces, Light, Shading

- Unit 3: Applied 3D Graphics Using OpenGL (6 Hrs)

  OpenGL Basics and Animation, Lighting in OpenGL, Texture Mapping and Textures in OpenGL

- Unit 4: Applied 3D Graphics Using Direct 3D (4 Hrs)

  Direct 3D: Basics, Lighting and Shading, Textures, and Animation

- Unit 5: 3D Modeling (6 Hrs)

  Scene Graphs, Lighting, Texture Mapping, Animation

- Unit 6: Visualization (8 Hrs)

  Visualization of experimental and simulated data. Fractals for visualization of complex and large data sets. Algebraic stochastic and Geometric fractals. Modeling of natural forms and textures using fractals; Visualization of multi variate relations. Flow visualization and hyper streamlines; Visualization of Meteorological, cosmological, seismic, biological data for scientific decision making.

References:

1. Peter Shirley, et al. Fundamentals of Computer Graphics, A K Peters, 2nd Edition, 2005.
2. Alan Watt, 3D Computer Graphics, Addison-Wesley, 3rd Edition, 1999.
3. Steve Cunningham, Computer Graphics: Programming, Problem Solving, and Visual Communication , California State University Stanislaus Turlock, CA, 2003
4. David S. Ebert, Musgrave, Peachey, Perlin Worley, Texturing & Modeling, Morgan Kaufmann Publishers, 3rd Edition, 2003.
5. Philip Schneider, David Eberly, Geometric Tools for Computer Graphics, Morgan Kaufmann Publishers, 2003.
6. Richard S. Gallagher, Solomon, Computer Visualization: Graphics Techniques for Engineering and Scientific Analysis, CRC, 1994.

7. Alan Watt , M. Watt, Advanced Animation and Rendering Techniques, ACM Press, 1992

DE: Linux Kernel Programming

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Develop the ability to read and understand Linux kernel source code.
2. Develop the ability to write Linux kernel device drivers
3. Develop the ability to handle synchronization issues in kernel code
4. Understand the broader picture of the open source world and process of open source development

Syllabus Contents:

- Unit 1 - Introduction (5 Hrs)

  Basic operating system concepts review, an overview of the Unix file system, an overview of Unix kernels, Linux kernel source code – organization, building the kernel, gdb and debugging techniques, code browsing tools, review of Intel Pentium architecture, module programming – writing and inserting a module in kernel

- Unit 2 - Virtual File System and Device drivers (7 Hrs)

  System calls, virtual file system, registering and mounting, file system debugger, ext2 and ext3 file systems, disk cache and swapping, device drivers: character, block and other devices, character and block device operations

- Unit 3 - Processes (7 Hrs)

  Overview of the boot process, grub the boot loader, preliminary setup and overview of kernel startup and initialization, swapper, init and initial processes, process switching, scheduling policy, the scheduling algorithm, data structures used by the scheduler, functions used by the scheduler, unqueue balancing in multiprocessor systems, lightweight processes and threads

- Unit 4 - Kernel Synchronization (7 Hrs)

  How the kernel services requests, synchronization primitives, spinlocks, semaphores;mutexes, reader/writer locks, read-copy-update mechanism, synchronizing accesses to kernel data structures, examples of race condition prevention, locking and interprocess communication

- Unit 5 - Memory Management (7 Hrs)

  Segmentation and paging in hardware and in the kernel, page cache and buffer cache, Page frame management, memory area management, slab allocator, noncontiguous memory area managemn, caching (kmalloc) and process address space (vmalloc), swapping

- Unit 6 - Exceptions and Interrupts (5 Hrs)

  The role of interrupt signals, interrupts and exceptions, nested execution of exception and interrupt handlers, initializing the interrupt descriptor table, exception handling, interrupt handling, softirqs and tasklets, work queues, returning from interrupts and exceptions

References:

1. Daniel P. Bovetand Marco Cesati,Understanding the Linux Kernel,O'Reilly Media, 3rd Edition, 2005
2. Wolfgang Mauerer, Professional Linux Kernel Architecture, Wiley Publishing, 2008.
3. Jonathan Corbet, Alessandro Rubiniand Greg Kroah-Hartman.,Linux device drivers", O'Reilly Media, 3rd Edition, 2005
4. Siever, Stephen Figgins, Robert Love, Arnol-Robbins, Linux in a Nutshell, O'Reilly Media, 6th Edition, 2009

PG laboratory I

Teaching Scheme	Examination Scheme
Practical: 4 hrs/week	Term Work: 50 marks Oral Examination: 50 marks

Course Outcomes:

1. Relate theory with practice by performing programming assignments related subjects such as Advanced Computer Networks, Topics in Databases etc

2. Get proficiency in designing programming solutions
3. Get proficiency in variety of tools and environments like C, C++, Java, Oracle database, Linux OS
4. Analyze various algorithms and implementation options to solve a problem
5. Learn to work in teams while carrying out the assignments
6. Imbibe good programming practices

Syllabus Contents:

- It should consist of representative practical / simulation assignments related to all core subjects and electives studied in the current semester

(MLC) Research Methodology

Teaching Scheme
Practical: 1 hr/week

Examination Scheme
End-Sem Examination: 50 marks

Course Outcomes:

1. Understand research problem formulation
2. Study various approaches of investigation of solutions for research problems
3. Learn effective literature survey approaches
4. Learn ethical practices to be followed in research
5. Apply research methodology in case studies
6. Acquire skills required for presentation of research outcomes (report and technical paper writing, presentation etc.)

Syllabus Contents:

- Unit 1 (2 Hrs)

  Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

- Unit 2 (3 Hrs)

  Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

- Unit 3 (3 Hrs)

  Effective literature studies approaches, analysis

- Unit 4 (2 Hrs)

  Plagiarism , Research ethics

- Unit 5 (2 Hrs)

  1. Effective technical writing, how to write report, Paper
  2. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, “Research Methodology: A Step by Step Guide for beginners”, 2nd Edition

(MLC) Humanities

Teaching Scheme	**Examination Scheme**
Lectures: 1 hr/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the development of Civilization, Culture and Social Order over the Centuries
2. Analyze the impact of development of Technology on the Society’s Culture and vice-versa
3. Understand the concept of Globalization and its effects.
4. Compare the positive and negative effects of Industrialization and Urbanization,

5. Appreciate the need of Humanities learning in engineering education

Syllabus Contents:

- Introduction: (1 Hr.)
  The meaning of Humanities and its scope. The importance of Humanities in Society in general and for Engineers in particular.

- Social Science and Development: (6 Hrs.)
  Development of Human Civilization over the centuries, Society and the place of man in society, Culture and its meaning, Process of social and cultural change in modern India, Development of technology, Industrialization and Urbanization, Impact of development of Science and Technology on culture and civilization Urban Sociology and Industrial Sociology – the meaning of Social Responsibility and Corporate

  Social Responsibility – Engineers' role in value formation and their effects on society.

- Introduction to Industrial Psychology: (7 Hrs.)
  The inevitability of Social Change and its effects -- Social problems resulting from economic development and social change (e.g. overpopulated cities, no skilled farmers, unemployment, loss of skills due to automation, addictions and abuses, illiteracy, too much cash flow, stressful working schedules, nuclear families etc.) – Job Satisfaction -- The meaning of Motivation as a means to manage the effects of change – Various theories of Motivation and their applications at the workplace (e.g. Maslow's Hierarchy of Needs, McGregor's Theory X and Y, The Hawthorne Experiments, etc.) – The need to enrich jobs through skill and versatility enhancement – Ergonomics as a link between Engineering and Psychology

References:

1. Jude paramjit S and Sharma Satish K, "Ed: dimensions of social change"
2. Raman Sharma, "Social Changes in India"
3. Singh Narendar, "Industrial Psychology", Tata McGraw-Hill, New Delhi, 2011
4. Ram Ahuja, "Social Problems in India"

SEMESTER - II

Advanced Algorithms

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand advanced algorithm design techniques such as randomized algorithms, approximation algorithms

2. Discuss different areas such as network flows, number theory and utilize concepts therein to develop algorithms in various domains

3. Design and implement various algorithms

4. Evaluate the implementations with respect to time and space complexity

5. Discuss active areas of research in Algorithms

Syllabus Contents:

- Unit 1 (6 Hrs)

  Probabilistic Analysis and Randomized Algorithms: The Hiring Problem, Indicator Random Variables, Randomized Algorithms.Network Flow and Matching: Flows and Cuts, maximum Flow, Maximum Bipartite Matching, Minimum-Cost Flow, Efficiency Analysis

- Unit 2 (6 Hrs)

  Text Processing: String and pattern matching algorithms, tries, text compression, text similarity testing, performance analysis.

- Unit 3 (6 Hrs)

  Number Theory Algorithms: Elementary Number Theory algorithms like Euclid's GCD algorithm, modular arithmetic algorithms, primality testing, polynomials and FFT, representation of polynomials, DFT, FFT algorithm, Multiplying Big Integers.

- Unit 4 (6 Hrs)

  Parallel Algorithms: Model for parallel computation, basic techniques, parallel evaluation of expressions, parallel sorting networks, parallel sorting

- Unit 5 (6 Hrs)

  Computational Geometry Algorithms: Range trees, Priority Search trees, Quadtrees and k-D trees, Plan Sweep Technique, Convex Hulls

- Unit 6 (6 Hrs)

  NP-Completeness and Approximation Algorithms: Polynomial time, Polynomial time verification, NP-completeness and reducibility, profs, NP-completeness examples, Vertex Cover problem, Travelling Salesman Problem, Set Covering Problem

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 3rd Edition, 2009.
2. Michael T. Goodrich and Roberto Tamassia, Algorithm Design Foundations, Analysis, and Internet Examples, John Wiley & Sons, Inc., 2nd Edition, 2009.
3. Gilles Brassard and Paul Bratley, Fundamentals of Algorithmics, Prentice Hall, 1996.

Security in Computing

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand basic issues, concepts, principles, and mechanisms in network security
2. Determine appropriate mechanisms such as encrypt, decrypt and transmit messages using cryptographic techniques for protecting networked systems
3. Learn the functioning of security services by analyzing the vulnerabilities and threats in various computing environments
4. Implement proof of concept for various security techniques/algorithms
5. Learn the basic system security mechanisms, such as those used in operating systems, file systems and computer networks
6. Discuss the issues concerning various threats to wireless networks, encryption and decryption

Syllabus Contents:

- Unit 1: Introduction (6 Hrs)

Cryptography and Modern Cryptography, Basic concepts: threats, vulnerabilities, controls; risk; Security services, security policies, security mechanisms. Active vs. Passive attacks, Historical Ciphers and Their cryptanalysis, one time passwords (Vernam's Cipher)

- Unit 2: Number Theory (6 Hrs)

  Review of number theory and algebra, computational complexity, probability and information theory, primality testing, the Euclidean algorithm – Congruences: Definitions and properties – linear congruences, residue classes, Euler's phi function – Fermat's Little Theorem – Chinese Remainder Theorem

- Unit 3: Symmetric Key Encryption (6 Hrs)

  Cryptography and cryptanalysis, DES, Triple DES, AES, IDEA, CAST-128, RC4, Modes of operation.

- Unit 4: Public Key Cryptography (6 Hrs)

  RSA cryptosystem, Diffie-Hellman, Elliptic curve cryptography, Rabin, ElGamal, Goldwasser-Micali, Blum-Goldwasser cryptosystems.

- Unit 5: Threats To Wireless Network (6 Hrs)

  Wireless availability, Privacy Challenges. Risks: denial of Service, Insertion Attacks, interception and monitoring wireless traffic, Mis-configuration. Wireless Attack: Surveillance, War Driving, Client-to-Client Hacking, Rogue Access Points, Jamming and Denial of Service.

- Unit 6: Wireless Network Security (6 Hrs)

  Access Point-Based Security Measures, Thin Party Security Methods, Funk's Steel-Belted Radius, VVLAN Protection Enhancements, Blue-tooth Security Implementation, Security in WIMAX, UWB security, Satellite network security

References:

1. C. Pfleeger and S. Pfleeger, Security in Computing, Prentice Hall,4th Edition, 2007.

2. William Stallings, Cryptography and Network Security, Prentice Hall, 4th Edition, 2006
3. Behrouz A Forouzan, Cryptography & Network Security, McGraw-Hill, 2008
4. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill, 2nd Edition, 2008.
5. Eric Maiwald, Fundamentals of Network Security, McGraw-Hill, 2004.
6. Jay Ramachandran, Designing Security Architecture Solutions, Wiley Computer Publishing, 2002.
7. Bruce Schneier, Applied Cryptography, John Wiley & Sons Inc, 2001.
8. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security Private Communication in a public world, Prentice Hall of India Private Ltd., New Delhi
9. William Stallings, Network Security Essentials Applications and Standards, Pearson Education, New Delhi.

Data Mining and Machine Learning

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand Supervised, unsupervised and semi supervised machine learning algorithm
2. Study of probabilistic analysis, parametric and non-parametric algorithms
3. Estimation of Maximum Likelihood, losses and risks for sample implementation
4. Study and Compare various classification, association, clustering algorithms
5. Apply data mining algorithms for solving real life problems
6. Discuss active areas of research in Data Mining and Machine Learning

Syllabus Contents:

- Unit1: Introduction (6 Hrs)

  Introduction to data mining, Applications, Motivation, Data mining knowledge discovery process, kinds of data, data mining techniques, issues in data mining

Introduction to Machine Learning: What is machine learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning with applications and issues.

- Unit 2: Input, Output and Data Pre-processing (6 Hrs)
  - Input : Concepts, instances and attributes
  - Output: Knowledge Representation: Decision tables, Decision trees, Decision rules, Rules involving relations, Instance-based representation.
  - Data Pre-processing-data cleaning, data integration and transformation, data reduction, data discretization and concept hierarchy generation.

- Unit 3: Classification , Diagnostic and Prediction (8 Hrs)
  Introduction to Classification, issues regarding classification, Classification : Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization.

  Diagnostic: debugging a learning algorithm, evaluating a hypothesis(Model selection), training/validating/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves.

  Accuracy and Error measures: classifier accuracy measures, predictor error measure, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, tradeoff between both, accuracy.

- Unit 4: Decision tree, Probabilistic classifier, Clustering (6 Hrs)
  - Decision Tree : representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data
  - Probabilistic classifier: Bayes rule, Maximum Likelihood Estimation, case study
  - Clustering :Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm

- Unit 5: Association Rule Mining and Support Vector Machines (6 Hrs)

Mining Frequent Patterns, Associations and Correlations: Basic concepts, Apriori algorithm for finding frequent itemsets using candidate generation, generating association rules from frequent itemsets, from association to correlation analysis

Support Vector Machines: Objective(optimization), hypothesis, SVM decision boundary, kernels : RBF and others.

- Unit 6: Advanced Techniques (6 Hrs)

  Mining time-series data for trend analysis, text mining, social network analysis, web mining, spatial mining, temporal mining

Text Books:

1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
2. Jiawei Han Micheline Kamber, Data Mining Concepts and Techniques, Latest Edition

References:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2005
2. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001
3. K.P. Soman, R. Longonathan and V. Vijay, Machine Learning with SVM and Other Kernel Methods, PHI-2009
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer 2006.
5. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001
6. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000

DE: Advanced Topics in Graph Theory

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand topics such as matching, graph colouring, Ramsey theory etc
2. Discuss algorithmic aspect of graph theory
3. Design solutions using graph theory for other domain problems

4. Implement graph algorithms and learn to address issues related to handling very large graphs
5. Evaluate tools built for handling very large graphs
6. Get to know of active research areas in computer science (theory)

Syllabus Contents:

- Unit 1: Trees (6 Hrs)

  Basic Properties, Spanning Trees and Enumeration, Enumeration of Trees, Spanning Trees in Graphs, Decomposition and Graceful Labeling, Optimization and Trees, Minimum Spanning Tree.

- Unit 2: Matching and Factors (6 Hrs)

  Matchings in Bipartite Graphs, Hall's Matching Condition, Min-Max Theorems, Independent Sets, Tutte's 1-Factor Theorem, Maximum Bipartite Matching , Weighted Bipartite Matching, Stable Matching, Faster Bipartite Matching

- Unit 3: Connectivity and Paths (6 Hrs)

  Cuts and Connectivity, Flows in Directed Graphs, Connectivity and Menger's Theorem, Edge-Connectivity, Blocks, K-connected Graphs and k-edge-connected Graphs, 2-connected Graphs, Applications of Menger's Theorem

- Unit 4: Graph Coloring (8 Hrs)

  Vertex Colorings and Upper Bounds: Definitions , Upper bounds, Brooke's Theorem, Structure of k-chromatic Graphs, Graphs with Large Chromatic Number, Critical Graphs, Counting Proper Colorings, Chordal Graphs, A Hint of Perfect Graphs, Line Graphs and Edge Colorings, Characterization of Line Graphs.

- Unit 5: Ramsey Theory (4 Hrs)

  The Fundamental Ramsey Theorems, Canonical Ramsey Theorems, Ramsey Theory for Graphs

- Unit 6: Random Graph (4 Hrs)

  Existence and Expectation, Properties of Almost All Graphs, Threshold Functions, Evolution and Properties of Random Graphs, Connectivity, Cliques and Colorings

- Unit 7: Extremal Problems (6 Hrs)

  Paths and Cycles, Complete Subgraphs, Hamilton Paths and Cycles, Szemeredi's Regularity Lemma and its simple applications, Encodings of Graphs, Branchings and Gossip, List Colorings and Choosability, Circumference

References:

1. Douglas B. West, Introduction to Graph Theory, Prentice-Hall, 3rd Edition, 2008
2. Béla Bollobás, Modern Graph Theory, Springer, 1998.

DE: Cloud, Virtualization and Big Data

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Characterize the distinctions between various cloud models and services
2. Compare the functioning and performance of virtualization of CPU, memory and I/O with traditional systems
3. Acquire deep understanding of Hadoop architecture and demonstrate the use of Map-Reduce programming for data analytics
4. Familiar with OpenStack components to create a cloud infrastructure
5. Analyze the security risks associated with cloud computing and evaluate how to address them

Syllabus Contents:

- Unit 1: Introduction (6 hrs)

  Benefits and challenges to Cloud architecture, Cloud delivery models- SaaS, PaaS, LaaS. Cloud Deployment Models- Public Cloud, Private Cloud External Cloud and Hybrid Cloud, Service level agreements in clouds

Role of virtualization in enabling the cloud, Levels of Virtualizations, Types of Virtualization: Compute, Network and Storage Virtualizations, Virtual Machine, Hypervisor: Type 1 and 2

- Unit 2: Server Virtualization (6 hrs)

  X86 architecture, Protected mode, Rings of Privileges, Virtualization challenges, Full virtualization and Binary Translation, ESXi, Para-Virtualization, Xen, Hardware Assisted Virtualization, System call and hardware interrupts handling in virtualized systems, Intel VTx, KVM

- Unit 3: Memory and I/O Virtualization (8 hrs)

  Memory management and I/O with traditional OS, Challenges in virtualized system, Shadow page Tables in Full Virtualized system, EPT/NPT, 2d Page walks, I/O in Virtualized Systems, Emulation, Split drivers of Xen, Direct I/O, Intel VTd, VMCS,

- Unit 4: Cloud Orchestration (4hrs)

  Elements of Cloud Orchestration, Examples platforms: OpenStack and vSphere

  OpenStack Deep dive: Covers Networking, Storage, Authentication modules of OpenStack, Nova, Quantum, Keystone and Cinder, Swift

- Unit 5: Big Data in the Cloud (10 hrs)

  Data in the cloud, Map Reduce – Hadoop Framework, HDFS, Map-Reduce programming, examples, Job Execution in Hadoop Runtime, Shuffle and Sort, Hive, Pig, Greenplum, Mahout, Hbase

- Unit 6: Cloud Platforms and Cloud Security (4 hrs)

  Cloud Platforms: Azure Overview and Architecture, Google App Engine Overview, Amazon Web Services

  Cloud Security: Issues with Multi-tenancy, Isolation of users/VMs from each other, VM vulnerabilities, hypervisor vulnerabilities, VM migration attacks, Cloud security such as developing cloud security models, end-to-end methods for enforcing, Security policies and programming models with privacy aware APIs

References:

1. Danielle Ruest and Nelson Ruest, Virtualization, A beginners Guide, Tata McGraw Hill,
2. Tom White, Hadoop: The Definitive Guide, O'REILLY, 3rd Edition, 2012
3. Dinakar Sitaram and Geetha Manjunath, Moving to the cloud, Elsevier
4. Kai Hwang, Geoffrey and KJack, Distributed and Cloud computing, Elsevier

DE: Business Analytics

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam – 60

Course Outcomes:

1. Understand business problems and learn the role and importance of Business Analytics (BA) in making use of available big data in decision making
2. Plan, organize and evaluate methods to prepare raw data for business analytics, including partitioning data and imputing missing values
3. Compare and contrast different BA techniques
4. Build mathematical models using statistics and analysis methods
5. Interpret, analyze and validate the results
6. Develop skills of programming to handle big data

Syllabus Contents:

- Unit – 1: Big Data and Business Analytics (3 Hrs)

  Characteristics and Challenges of Big data. Evolution of Business Analytics, Scope of Business Analytics, Decision Models, Problem Solving and Decision Making, Data Cleaning and Data Preparation for analysis

- Unit – 2: Descriptive Analytics (4 Hrs)

  Visualizing and Exploring Data: Univariate and Multivariate Data Visualization (With different Graphical Methods), Guidelines for Model Building

- Unit – 3: Predictive Analytics (8 Hrs)

  A. Classification

  Linear Discriminant Analysis, Logistic Regression, Decision Trees (CHAID / C-4.5 etc), Perceptron Algorithm, Back Propagation Neural Networks.

  B. Regression (Function Approximation)

  Multiple Linear Regression, Neural Networks

  C. Model selection in Classification and Regression

  How to interpret models and make business sense? Goodness of Fit Measures, Different Model Evaluation Criteria

- Unit – 4 : Time Series Analysis (6 Hrs)

  Introduction to Time Series Analysis, Autocorrelation and Partial Autocorrelation, Conditions for stationary and invertible process, Box-Jenkins approach, Models for Stationary Time Series, Auto Regressive Processes, Moving Average models, Exponential Smoothing, Forecasting and Applications

- Unit – 5: Segmentation Methods (4 Hrs)

  Cluster Analysis, Factor Analysis

- Unit – 6: Optimization (8 Hrs)

  Linear Programming & Applications, Transportation problems, Assignment problems, Game Theory & applications

- Unit – 7: Programming Business Analytics in R (3 Hrs)

  Infrastructure and Interfaces, Manipulating Data, Simple Analysis using R, Exploring Data and building models.

References:

1. James R. Evans, "Business Analytics: Methods, Models, and Decisions", Pearson 2012

2. R for Business Analytics, A Ohri, Springer Verlag, 2012

DE: Embedded System Design

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Explain Characteristics & Salient Features of Embedded Systems
2. Analyze Architecture & Recent Trends of Embedded Systems
3. Discuss PIC and ARM families
4. Understand general process of embedded system development and implement them
5. Explain communication interface for wired and wireless protocols
6. Discuss hardware and software design methodologies for embedded systems

Syllabus Contents:

- Unit 1: Overview of Embedded Systems (4 Hrs)

  Introduction, Definition, Characteristics & Salient Features, Classification, Application Areas, Overview of Embedded System Architecture & Recent Trends

- Unit 2: Hardware Architecture (8 Hrs)

  Embedded Hardware based on Microprocessors, Microcontrollers & DSPs. Study of PIC Microcontrollers: PIC16F887 & Applications. Study of ARM Family : ARM Classic Family : ARM 7 Detailed Study of ARM7-TDMI including Core Architecture, ARM/Thumb State, On Chip Debug & Development Support, AMBA Bus, Applications. ARM Cortex Family: A,R & M Profiles (A15, R5 & M3 Architectures) & Applications.

- Unit 3: Communication Interface (6 Hrs)

  Serial , Parallel, Wired Wireless Protocols, Wired : CAN ,I2C,USB, FireWire, Wireless : Blue Tooth , IrDA, IEEE802.11

- Unit 4: Software Architecture (6 Hrs)

  Concepts: Embedded OS, Real-Time Operating Systems (RTOS), Detailed Study of RT

Linux ,Hand Held OS, Windows CE. & Development Tools

- Unit 5: Embedded Systems for Automotive Sector (6 Hrs)

  Electronic Control Units (ECU) for Engine Management, Antilock Braking System (ABS), Crusie Control, Design Challenges, Legislative Emission Norm, Interface Standards, Developmental Tools Navigation Systems : Global Positioning System (GPS):Detailed Study & Applications

- Unit 6: (4 Hrs)

  Smart Cards: Classifications, Interfacing, Standards & Applications

  RFID Systems: Technology, RFID Tag ,RFID Reader, Applications

- Unit 7: Case Studies (6 Hrs)

  Embedded System for Mobile Applications, DSP Based Embedded System, Networked Embedded System & Digital Camera

References:

1. K.V.K. Prasad, Embedded / Real Time Systems: Concepts, Design and Programming Black Book, Dreamtech Press, 2005.
2. Vahid F. and Givargies T., Embedded Systems Design, John Wiley X. Sons, 2002
3. John B Peatman, Design with PIC Microcontrollers, Pearson Education, 1998
4. Liu, Real-Time Systems, Pearson Education, 2000.
5. Technical Manuals of ARM Processor Family available at ARM Website on Net

DE: Bioinformatics

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the basics of biology required to work in the field of bioinformatics
2. Learn various algorithms for sequencing and alignments
3. Implement proof of concepts for the algorithm studied with some sample data
4. Compare the various algorithms on different parameters

5. Study and use various tools and biological databases for genomics

6. Apply the molecular biology techniques for drug design for various diseases

Syllabus Contents:

- Unit 1 (6 Hrs)

  Introduction, chronological history of Bioinformatics, evolution of Bioinformatics, Objectives of Bioinformatics, Importance of bioinformatics, Bioinformatics in business, future scope of Bioinformatics.

- Unit 2 (6 Hrs)

  Bioinformatician and bioinformaticist, role, need and importance of Biology, Computer Science, mathematics and information technology in bioinformatics, biological classification and nomenclature, life in space and time.

- Unit 3 (6 Hrs)

  Introduction, information networks, protein and genome information resources, DNA sequence analysis, pairwise alignment techniques, multiple alignment techniques, secondary databases, analysis packages.

- Unit 4 (6 Hrs)

  The dawn of sequencing, the biological sequence or structure deficit, human genome project and its status, homology and analogy, web browsers.

- Unit 5 (6 Hrs)

  Molecular biology networks, National centre for biotechnological information, specialized genomic resources. Building a sequence search protocol, practical approach for structural and functional interpretation.

- Unit 6 (6 Hrs)

  Introduction to analysis package, commercial databases, softwares and comprehensive packages, internet packages specializing in DNA and protein analysis.

References:

1. T.K. Attwood and Parry Smith, Introduction to Bioinformatics, Benjamin-Cummings Publishing Company, 2001.
2. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 3rd Edition, 2008
3. Krane and Raymer, Fundamental Concepts in Bioinformatics, Benjamin-Cummings, 2002.

DE: Advanced Compiler Construction

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the design of a modern compiler
2. Study code generation and optimization techniques
3. Design and implement a toy compiler
4. Study principles of Data Flow Analysis
5. Simulation of instruction sequencing and register allocation algorithms
6. Case Study – understanding 'gcc' code

Syllabus Contents:

- Unit 1: Introduction (6 Hrs)

  Review of Compiler Structure, Advanced Issues in Elementary Topics, Importance of Code Optimization, Structure of Optimizing Compilers, Placement of Optimizations in Aggressive Optimizing Compilers

- Unit 2: Context –Sensitive Analysis & Intermediate Representation (6 Hrs)

  Introduction to type systems, The Attribute –grammar framework, Adhoc Syntax directed translation, Harder problems in type inference and changing associativity, Issues in designing an intermediate languages, Graphical & Linear IR, Static-single Assignment form, Mapping values to names & symbol tables.

- Unit 3: Code Optimization (8 Hrs)

  Introduction, Redundant expressions, Scope of optimization, Value numbering over regions larger than basic blocks, Global redundancy elimination, Cloning to increase context, Inline substitution, Introduction to control flow analysis, Approaches to control flow analysis, Interval analysis and control trees, Structural analysis, Reaching definitions.

- Unit 4: Data Flow Analysis & Scalar Optimization (10 Hrs)

  Basic concepts : Lattices, flow functions and fixed points, Iterative data flow analysis, Lattice of flow functions, Control –tree based data flow analysis, Structural analysis and interval analysis, Static Single Assignment (SSA) form, Dealing with arrays, structures and pointers, Advanced topics: Structures data-flow algorithms and reducibility, Inter procedural analysis (Control flow, data flow, constant propagation, alias), Inter procedural register allocation, Aggregation of global references, Introduction to scalar optimization, Machine –independent and dependent transformations, Example optimizations (eliminating useless and unreachable code, code motion, specialization, enabling other transformation, redundancy elimination)., Advanced topics (Combining optimizations, strength reduction).

- Unit 5: Instruction Selection & Scheduling (8 Hrs)

  Introduction, Instruction selection and code generation via Sethi Ullman, Aho Johnson algorithm, Instruction selection via tree-pattern matching, Instruction selection via peephole optimization, Learning peephole patterns, Generating instruction sequences, Introduction to instruction scheduling, The instruction scheduling problem, List scheduling, Regional scheduling.

- Unit 6:Register Allocation (6 Hrs)

  Introduction, Issues in register allocation, Local register allocation and assignment, Moving beyond single block, Global register allocation and assignment, Variations on Graph Coloring Allocation, Harder problems in register allocation, CASE Study of GCC compiler.

References:

1. Keith D. Cooper and Linda Torczon, Engineering a Compiler, Elsevier-Morgan Kaufmann Publishers, 2004.

2. Steven S. Muchnick, Advanced Compiler Design Implementation, Elsevier-Morgan Kaufmann Publishers, 2003.
3. Andrew Appel, Modern Compiler Implementation in C: Basic Techniques, Cambridge University Press, 1997.
4. Y.N. Srikant, Priti Shankar, The Compiler Design Handbook: Optimizations and Machine Code Generation, CRC Press, 2nd Edition, 2002.
5. Uday Khedker, Amitabha Sanyal, Bageshri Karkare , Data Flow Analysis: Theory and Practice, CRC Press, 2009
6. David R. Hanson , Christopher W. Fraser, A Retargetable C Compiler: Design and Implementation, Addison-Wesley, 1995
7. Morgan, Robert, Building an Optimizing Compiler, Digital Press Newton, 1998.
8. John Levine, Tony Mason & Doug Brown, Lex and Yacc, O'Reilly

SLC: MOOC (Massive Open Online Course)

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Learn how to search effectively and use the wealth of information freely available on Internet judiciously
2. Imbibe the habit of self learning
3. Get exposure to learning from world class professors
4. Course specific outcomes

Syllabus Contents:

Students will be given a list of courses with video lectures delivered by renowned professors available. Based on the response, 1 or 2 courses will be officially finalized and a regular faculty member will be assigned to the selected course(s). The assigned faculty member(s) will address queries of students related to the video lectures and will also be responsible for evaluation of the students just like any other regular subject by conducting quizzes and end-semester examination as per the academic calendar.

PG laboratory II

Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/week	Term Work: 50 marks Oral Examination: 50 marks

Course Outcomes:

1. Relate theory with practice by performing programming assignments related to subjects such as Advanced Algorithms, Security in Computing etc
2. Get proficiency in designing programming solutions
3. Get proficiency in variety of tools and environments like C, C++, Java, Oracle database, Linux OS
4. Analyze various algorithms and implementation options to solve a problem
5. Learn to work in teams while carrying out the assignments
6. Imbibe good programming practices

Syllabus Contents:

- It should consist of representative practical / simulation assignments related to all core subjects and electives studied in the current semester

MLC: Intellectual Property Rights

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2. Understand that IPR would take such important place in growth of individuals and nation. It is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
3. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

- UNIT 1 (6 Hrs)

Introduction: Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

- UNIT 2 (4 Hrs)

  International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

- UNIT 3 (4 Hrs)

  Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

- UNIT 4 (4 Hrs)

  New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Softwares etc. Traditional knowledge Case Studies, IPR and IITs.

- UNIT 5 (4 Hrs)

  Registered and unregistered trademarks, design, concept, idea patenting.

References:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
2. Mayall , "Industrial Design", Mc Graw Hill
3. Niebel , "Product Design", Mc Graw Hill
4. Asimov , "Introduction to Design", Prentice Hall
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age".
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.

SEMESTER - III

Dissertation Phase – I

Course Outcomes:

1. Learn how the available literature can be searched for gathering information

about a problem/domain

2. Understand the current status of the technology/research in the selected domain
3. Understand software engineering principles related to requirements gathering and analysis
4. Understand how to evaluate different design techniques and methods to find out the best feasible solution under given constraints for the given problem
5. Understand how to write requirements analysis and design documents

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

The dissertation should have the following:

i. Relevance to social needs of society

ii. Relevance to value addition to existing facilities in the institute

iii. Relevance to industry need

iv. Problems of national importance

v. Research and development in various domain

The student should complete the following:

1. Literature survey
2. Problem Definition
3. Motivation for study and Objectives
4. Preliminary design / feasibility / modular approaches

SEMESTER - IV

Dissertation Phase – II

Course Outcomes:

1. Understand software engineering principles related to implementation and testing of software solutions

2. Get a glimpse of how large software are implemented, tested and maintained
3. Understand how to document a large software for making it comprehensible and maintainable
4. Understand how effective testing is an important aspect of software development
5. Understand how to present the work done in various forms (technical report/paper/presentation) at various platforms (conferences/journals/defense of the dissertation etc)

The student should complete the following:

1. Implementation of the proposed approach in the first stage
2. Testing and verification of the implemented solution
3. Writing of a report and presentation
4. (Not mandatory but desired) Publish the work done at suitable conference/in a journal