Honors
in
B. Tech. (Computer Science and Engineering)

Scheme & Syllabi

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme and Syllabus of Honors in BTech CSE

Fifth Semester					
	CSTxxx	Advance Data Structures and Algorithms		3	
	CSTxxx	Honors Elective-1*		3	
				6	

Sixth Semester					
	CSTxxx	Honors Elective-2*		3	
	CSTxxx	Honors Elective-3*		3	
				6	

Seventh Semester					
	22CSTxxx	Honors Elective-4*		3	
				3	

Eighth Semester					
	22CSTxxx	Honors Elective-5*		3	
				3	

Advanced Data Structures and Algorithms (Honors)					
Prerequisite: Data Structures, Design and Analysis of Algorithms		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations.				8
Unit 2	Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Redblack trees, B-trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication.				10
Unit 3	Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization.				10
Unit 4	Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover, Randomized algorithms, Probabilistic algorithms.				8
Unit 5	Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions, undecidability				6
References:					
1.	Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India.				
2.	Aho A.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley				
3.	Brassard : Fundamental of Algorithmics, PHI.				
4.	Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education.				
5.	Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity, PHI				
6.	Motwani and Raghavan: Randomized Algorithms, Cambridge University Press				

Honors Electives: 3-0-0 (Credits 3)

	Honors Electives	Credit	L	T	P
1.	Advances in Compiler Design	3	3	0	0
2.	Android Programming	3	3	0	0
3.	Big Data Analytics	3	3	0	0
4.	Cloud Security	3	3	0	0
5.	Cyber Security	3	3	0	0
6.	Data Compression	3	3	0	0
7.	Data Visualization	3	3	0	0
8.	Digital Forensic	3	3	0	0
9.	Distributed Systems	3	3	0	0
10.	E-commerce	3	3	0	0
11.	Embedded System Security	3	3	0	0
12.	Hardware Software Codesign	3	3	0	0
13.	Image Analysis	3	3	0	0
14.	Intrusion Detection	3	3	0	0
15.	Neural Network	3	3	0	0
16.	Network on Chip	3	3	0	0
17.	Network Performance Modeling	3	3	0	0
18.	Parallel Processing & Algorithms	3	3	0	0
19.	Parallelizing Compiler	3	3	0	0
20.	Pattern Recognition	3	3	0	0
21.	Public Key Infrastructure and Trust Management	3	3	0	0
22.	Quantum Computing	3	3	0	0
23.	Quantum Cryptography	3	3	0	0
24.	Real Time Systems	3	3	0	0
25.	Robotics and Control	3	3	0	0
26.	Security Analysis of Protocols	3	3	0	0
27.	Selected Topics in Cryptography	3	3	0	0
28.	Social Media Mining	3	3	0	0
29.	Software Project Management	3	3	0	0
30.	System on Chip	3	3	0	0
31.	Wireless Sensor Networks	3	3	0	0

Advances in Compiler Design					
Prerequisite: Basic course in Compiler Design		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Modern Compiler Design – Structure of Compilers for Modern Programming Languages, Cross Compiler, Just-In-Time (JIT) and Adaptive Compilation				8
Unit 2	Runtime System Architectures. Parser Development - LR Parsers and LR Grammars – Design and Implementation.				10
Unit 3	Parser and Ambiguity, Conflict Resolution, Lex and Yacc Tools. Optimizing Compiler - Control-flow Analysis, Control-flow Graphs, Basic Blocks.				10
Unit 4	Data-flow Analysis Methods, Dependence Analysis, Global Optimizations, Loop Optimizations.				8
Unit 5	Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling.				6
References:					
1.	Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. 3. 4.				
2.	Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann				
3.	Holub: Compiler Design in C, Prentice Hall India.				
4.	Keith Cooper and Linda Torczon : Engineering a Compiler, Morgan Kaufmann.				

Android Programming					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android Emulator Hello Android example, AndroidManifest.xml, R.java file, Activity, Fragment,				10
Unit 2	Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout. Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example				8
Unit 3	UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View.				8
Unit 4	Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API.				10
Unit 5	Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project.				6
References:					
1.	Official Android Website				

Big Data Analytics					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Overview of Database Management Systems, Introduction to Big Data, Introduction to distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics.				8
Unit 2	Apache Hadoop & Hadoop Eco-System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization. Hadoop Architecture.				10
Unit 3	Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name-Node, Secondary Name-Node, and Data-Node, Hadoop MapReduce paradigm, Map and Reduce tasks, Job.				10
Unit 4	Task trackers - Cluster Setup, SSH & Hadoop Configuration– HDFS Administering, Monitoring & Maintenance. Pig, Pig Latin Language, Hive Introduction, Hive queries. Spark Introduction. Cassandra CQL				8
Unit 5	Query language and CQL data model: Key space, Table definition, Column, and Data Types. Mongo DB Cluster analysis, K-means algorithm, Naïve Bayes, Parallel kmeans using Hadoop, parallel particle swarm algorithm using MapReduce, case studies on big data mining. Parallel swarm Intelligence.				6
References:					
1.	Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers, 2014				
2.	Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers,ISBN-13: 978-0321826626, 2017.				
3.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press)				
4.	John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowledge series).				

Cloud Security					
Prerequisite: Computer Networks, Operating System		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models				8
Unit 2	Virtualization: Types of Virtualization and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration.				10
Unit 3	Architectures:Standards, Orchestration, Provisioning, Portability, Interoperability, Federated Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control				10
Unit 4	Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud Initiative of Cloud Security Alliance (CSA).				8
Unit 5	Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural Issues, Evidence Collection and Analysis, Anti-Forensics, Incident Response, Standards and Framework				6
References:					
1.	K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011				
2.	R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley-Blackwell, 2011				
3.	S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012.				
4.	W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, 1st ed.: Addison-Wesley Professional, 2015.				
5.	T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/PearsonPTR, 2014				
6.	R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010				
7.	T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009.				
8.	V. (J. R.) Winkler, G. Speake, P. Foxhoven, Securing the Cloud: Cloud Computer Security Techniques and Tactics, Syngress, 2011.				

Cyber Security					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats, Need for a Comprehensive Cyber Security Policy. Cyber Security Safeguards (Overview): Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.				8
Unit 2	Network Security & Web Security: Security Issues in TCP/IP, which includes TCP, DNS, Routing (basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning, etc), Network Defense tools such as Firewalls, Filtering, DNSSec, NSec3, Distributed Firewalls.				10
Unit 3	Web Application Security: Cross-Site Scripting Attacks, Cross-Site Request Forgery, SQL Injection Attacks Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, AntiMalware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation				10
Unit 4	Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting diskbased analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating Email header information, Tracing Internet access, Tracing memory in real-time.				8
Unit 5	Security in Mobile Platforms: Android vs. ioS security model, threat models, information tracking, rootkits, Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, Spywares, and keyloggers and malware detection. Cyberspace and the Law				6
References:					
1.	Latest research papers, journals and articles				
2.	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelapure.				
3.	Cybersecurity Essentials By Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short · 2018				
4.	Cybersecurity: Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team TacticsBook by ErdalOzkaya and Yuri Diogenes				

Data Compression					
Prerequisite: Object Oriented Analysis and Design		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding.				8
Unit 2	Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov models.				10
Unit 3	Basic Coding Schemes: Statistical Methods - Shannon-Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression standards.				10
Unit 4	Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000				8
Unit 5	Motion Compensation, Temporal and Spatial Prediction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG-1/2 Audio Layers.				6
References:					
1.	Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier				
2.	David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London				

Data Visualization					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Modern Visualisation tools and techniques, Create multiple versions of digital visualizations using various software packages.				8
Unit 2	Identify appropriate data visualization techniques given particular requirements imposed by the data.				10
Unit 3	Apply appropriate design principles in the creation of presentations and visualizations; Analyse, critique, and revise data visualizations				8
Unit 4	Information overload and issues in decision making Design of visual encoding schemes to improve comprehension of data and their use in decision making				6
Unit 5	Use of Tableau - Data visualization tool for data analysts, scientists, statisticians, etc. to visualize the data and get a clear opinion based on the data analysis, Comparing classifiers- ROC curves, McNemar's test, other statistical tests.				10
References:					
1.	A first course Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge				
2.	The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001.				

Digital Forensics					
Prerequisite: Operating Systems, Computer Networks & Security		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	File System Forensics: Duplicating hard disks for "dead analysis", reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition				8
Unit 2	Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple disk volumes - RAID and disk spanning.				10
Unit 3	Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools				10
Unit 4	Web Forensics: network-based evidence in Windows and Unix environments, Reconstructing Web browsing, email activity, Tracing domain name ownership and the source of e-mails				8
Unit 5	System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication.				6
References:					
1.	Brian Carrier. File System Forensic Analysis, Addison Wesley				
2.	Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics, McGraw Hill. Course Technology.				
3.	Linda Volonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall.				
4.	Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley.				
5.	Vacca, John R., Computer Forensics Computer Crime Scene Investigation, Charles River Media.				
6.	Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation				

Distributed Systems					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to Distributed Systems, OS and Advanced OS, various distributed systems, Trends in Distributed System and challenges, Networking: network protocols, point-to-point communication. Introduction – Clocks, events and process states – Synchronizing physical clocks Logical time and logical clocks – Global states, Limitations, Lamport's logical clock, vector clock, causal ordering, global state, Cuts. Distributed Mutual Exclusion: Lamport, Recart-agrawala, and Maekawa's algorithms; Suzuki-kasami broadcast algorithm, and Raymond's tree based algorithm , Elections algorithms				8
Unit 2	Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit Distributed transactions: two phase commit, three-phase commit, ACID/BASE models Techniques of Inter process Communication: the API for internet protocols – External data representation and Multicast communication, Sun RPC: programming and implementation, Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Invocation – Introduction – Request-reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches – Distributed objects.				10
Unit 3	Case study: Enterprise Java Beans -from objects to components. Distributed Deadlock Detection: Resource Vs. Communication deadlock, Replication, Strategies to handle deadlock, Ho-Ramamoorthy, Path-Pushing, Edge-Chasing, Diffusion Computation based algorithms. Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems. Distributed Scheduling: Issues in Load Distribution, Components of a load distribution algorithm, Load Distribution Algorithms, V-system, Sprite, and Condor.				10
Unit 4	Network file systems: design, NFS, AFS (scale), DFS & CIFS (cache control), CODA (redundancy) Google File System (GFS), Hadoop Distributed File System (HDFS)Distributed Shared Memory: Algorithms for implementing DSMs, Memory Coherence, and Coherence Protocols, IVY Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation.				8
Unit 5	Resource Management: Introduction, Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach Recovery: Classification of failures, Synchronous and Asynchronous Check pointing and Recovery. Fault Tolerance: Commit Protocols, Voting Protocols, Failure Resilient Processes. Protection and Security: Access Matrix Model, Implementation of access matrix, Unix, and Amoeba. Case study-Distributed systems.				6
References:					
1.	Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems Principles and Paradigm," 2nd Edition, Pearson				
2.	George Coulouris, Jean Dollinmore, Tim Kindberg, Gordon Blair "Distributed Systems Concepts and Design," 5th Edition, Pearson				
3.	M. Singhal& N. Shivaratri, "Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems", Tata McGraw Hill, 2015				

4.	John Bloomer, "Power Programming with RPC," O'Reilly & Associates, Inc
5.	Advanced Programming in the Unix Environment by W. Richard Stevens, Addison-Wesley.
6.	Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education
7.	Distributed Systems - An Algorithmic approach by Sukumar Ghosh.

E-Commerce					
Prerequisite: knowledge of Digital Market, Basics of Computer Network and security		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction: Definition of Electronic Commerce, technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, E-Commerce Infrastructure, advantages and disadvantages, Impact of E-commerce on business, ECommerce Models.				8
Unit 2	Network Infrastructure for E- Commerce. Internet and Intranet based E-commerce: Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication. Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device				10
Unit 3	Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls. Encryption: Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption.				10
Unit 4	Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network. Customer Service Expectations of the E-commerce Experience.				6
Unit 5	Electronic Payments: Overview, The SET protocol, Payment: Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda				8
References:					
1.	Turban, "Electronic Commerce 2004: A Managerial Perspective", Pearson Education				
2.	Pete Lohsin , John Vacca "Electronic Commerce", New Age International				
3.	Bajaj and Nag, "E-Commerce the cutting edge of Business", TMH 6				
4.	Laudon, "E-Commerce: Business, Technology, Society", Pearson Education				

Embedded System Security					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Security Flaws and Attacks in Embedded systems: Code injection, Invasive and Non invasive physical and logical attacks				8
Unit 2	Defenses Against Code Injection Attacks: Methods using Address Obfuscation and Software Encryption, Anomaly Detection.				10
Unit 3	Safe Languages, Code Analyzers Compiler, Library, and Operating System Support for embedded systems				10
Unit 4	Security, Control Flow Checking, IP Protection: Encryption of IP Cores, additive and Constraint-Based watermarking.				8
Unit 5	Implementation of DES 3DES, AES, RC4, MD5, RSA algorithms				6
References:					
1.	Security in Embedded Hardware				

Hardware Software Codesign					
Prerequisite: Logic System Design/ Digital Logic Design		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Codesign overview, device Modeling and methodologies of system design				8
Unit 2	Hardware software partitioning and scheduling, Co simulation.				10
Unit 3	Synthesis and verifications, Architecture, Interface and reconfiguration.				10
Unit 4	System on chip, Application specific processors (DSP)				8
Unit 5	Codesign tools and case studies				6
References:					
1.	A Practical Introduction to Hardware/Software Codesign, Patrick Schaumont,Springer, 2009, ISBN 978-1-4419-5999-7				
2.	Specification and Design of Embedded Systems Daniel D. Gajski, Frank Vahid, S. Narayan, & J. Gong, Prentice Hall, 1994				
3.	Hardware / Software Co-Design: Principles and Practice,JStaunstrup and Wayne Wolf, Prentice Hall, 1994				

Image Analysis					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Image Preliminaries & Image Processing: Overview, Computer imaging systems, Human visual system, image model, etc. Geometric transformations: Translation, rotation, scaling and shearing.				8
Unit 2	Frequency transformation: Discrete Fourier transform (DFT), fast Fourier transform (FFT), shorttime Fourier transform (STFT), Multi-resolution Expansions: Wavelet Transforms in 1-D and 2- D. The Fast Wavelet Transform Wavelet Packets Transform				10
Unit 3	Feature Extraction and Dimension Reduction Color, Texture, Shape and structure Features in spatial and frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminant Analysis, Feature Reduction in Input and Feature Spaces. Image Segmentation. Gray-level thresholding, Supervised vs. Unsupervised thresholding, Binarization using Otsu's method, Locally adaptive thresholding.				10
Unit 4	Color-based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. Features Based Image Matching:Scale Space Image Processing.				8
Unit 5	Different Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, Vocabulary tree Panoramic Imaging, Template Matching, Mono Panorama, Stereo Panorama.				6
References:					
1.	J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition				
2.	Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007.				
3.	Bishop, Pattern Recognition and Machine Learning				
4.	Duda, Pattern Classification.				

Intrusion Detection					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction- Intrusion Detection System (IDS), Intrusion Prevention System (IPS).				8
Unit 2	Unauthorized access – buffer overflow, packet fragmentation, out-of-spec packets Review of Network protocol – TCP/IP, Intrusion detection through tcpdump				10
Unit 3	IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TCP, UDP and ICMP protocols and header formats.				10
Unit 4	Header information to detect intrusion, logs and their analysis.				6
Unit 5	IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT- A case study				8
References:					
1.	Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS.				
2.	Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention, McGraw Hill				
3.	Paul E. Proctor. The Practical Intrusion Detection Handbook, Prentice Hall.				
4.	Stephen Northcutt and Judy Novak. Network Intrusion Detection, SAMS.				

Neural Networks					
Prerequisite: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential.		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to Neural Architecture, McCulloch-Pitts networks, Learning Rules, Perceptrons.				8
Unit 2	Regression and least mean square algorithm, Multilayer perceptrons.				8
Unit 3	Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient, Radial-basis function networks.				10
Unit 4	Support vector Machines, Unsupervised learning and self-organization, Boltzmann machines and deep networks, Convolutional networks.				10
Unit 5	Recurrent networks, Associative Memories, Adaptive Resonance Theory, Applications of Neural Networks.				6
References:					
1.	Simon Haykin: Neural Networks: A Comprehensive Foundation, Pearson				

Network on Chip					
Prerequisite: Computer Architecture, Logic System Design		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	The Concept of route packet not wires for On-Chip Interconnection Networks, Topology and design architecture of Network-on-Chip, Area and power trade off NoC protocols.				8
Unit 2	Routing and Flow Control mechanism, Verification of Communications in Networkson-Chips. Application Mapping on Network-on-Chip.				10
Unit 3	Resource Allocation for QoS On-Chip Communication, routing techniques in different 2D/ 3D NoC topology, performance evaluation in terms of throughput, latency, gitter.				10
Unit 4	Signal Integrity and Reliability of Network-on-Chip, Testing of Network-on- Chip Architectures, Test and Fault Tolerance for NoC Infrastructures.				8
Unit 5	Reconfigurable Network-on-Chip Design, Security in NoCs. Energy and Power estimation techniques Network-on-Chips.				6
References:					
1.	Giovanni De Micheli, Luca Benini, DavideBertozzi, Networks on Chips:Technology and Tools, Morgan Kaufmann, 2006.				
2.	Fayez Gebali, HaythamElmiligi, Mohamed Watheq El-Kharashi, Networkson- Chips: Theory and Practice, CRC Press, 2017.				
3.	SudeepPasricha, NikilDutt, On-Chip Communication Architectures: System on Chip Interconnect, Morgan Kaufmann, 2010.				

Network Performance Modelling					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacity				8
Unit 2	Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min-plus and maxplus calculus, min-plus and max-plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses				6
Unit 3	Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stochastic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max-min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimation				11
Unit 4	Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Noncooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design. Case studies – (1) Selfish routing in networks and price of anarchy, (2) Oblivious routing, (3) Network resource allocation games.				11
Unit 5	Protocol Analysis: Modeling discrete event system using petri-nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets				6
References:					
1.	"Routing, Flow, and Capacity Design in Communication and Computer Networks", MichałPióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann				
2.	The Network Calculus Book by Jean-Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_files/NetCal.html				

3.	Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers
4.	Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at http://web.mit.edu/dimitrib/www/datanets.html
5.	"Network Optimization: Continuous and Discrete Models", D. Bertsekas
6.	Research Publications - will be discussed and distributed time to time

Parallel Processing & Algorithms					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O.				8
Unit 2	The PRAM Shared-Memory Model, Distributed-Memory or Graph Models, Circuit Model and Physical Realizations PRAM and Basic Algorithms, PRAM Submodels and Assumptions, Data Broadcasting, Semigroup or Fan-In Computation, Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS.				10
Unit 3	Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks.Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers.				10
Unit 4	Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Parallel Algorithm Complexity, Asymptotic Complexity, Algorithm Optimality and Efficiency, Complexity Classes, Parallelizable Tasks and the NC Class, Parallel Programming Paradigms, Solving Recurrences				8
Unit 5	Sorting and Selection Network: Design of Sorting Networks, Batcher Sorting Networks, Mesh-Base Architectures: Sorting on a 2D Mesh or Torus, Routing on a 2D Mesh or Torus, Numerical 2D Mesh Algorithms, Low-Diameter Architectures: Hypercubes and Their Algorithms, Sorting and Routing on Hypercubes				6
References:					
1.	J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992				
2.	F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo,California,1992				
3.	BehroozParhami, Introduction to Parallel Processing, Algorithms and Architecture, kluwer academic publishers,2002ed				

Parallelizing Compiler					
Prerequisite: Basic course in Compiler Design		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler.				8
Unit 2	Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis.				10
Unit 3	Direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, construction of data dependence and control dependence graphs.				10
Unit 4	Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop interchange and cycle shrinking transformation.				8
Unit 5	Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statements.				6
References:					
1.	Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann				
2.	Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann.				

Pattern Recognition					
Prerequisite: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential.		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier- ID3, C4.5. Discriminant functions: linear discriminant functions, piecewise linear discriminant functions, generalized discriminant functions.				8
Unit 2	Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and MahalanobisdistanceParametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator)				10
Unit 3	Non Parametric learning: Histogram estimator and Parzen windows, k-NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection- Inter/Intra class distance.				10
Unit 4	Feature extraction: Principal component analysis, Linear discriminant analysis.Unsupervised learning: Clustering, K- Means clustering, Fuzzy c-Means clustering, (Agglomerative) Hierarchical clustering				8
Unit 5	Estimating and Comparing Classifiers: No free lunch, Bias and variance trade-off, cross-validation and resampling methods, Measuring classifier performance, Comparing classifiers- ROC curves, McNemar's test, other statistical tests				6
References:					
1.	Pattern Classification, Duda Hart, Wiley				
2.	Pattern Recognition and Classification, Geoff Dougherty, Springer				
3.	Statistical Pattern Recognition, Andrew R Webb, Wiley				
4.	Pattern Recognition and Machine Learning, Christopher Bishop, Springer				
5.	Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI				

Public Key Infrastructure and Trust Management					
Prerequisite:		L	T	P	C
Total hours: 40		3	0	0	3
Course Content					Hrs.
Unit 1	Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross certification.				10
Unit 2	Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates PKI services – authentication, non-repudiation, privilege management, privacy, secure communication.				12
Unit 3	Key management – certificate revocation list, root CA, attacks on CA, key backup.				12
Unit 4	PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corners distribution. Certificate path processing – path construction and path validation.				6
References:					
1.	Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill				
2.	Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley.				
3.	John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services, AUERBACH.				
4.	Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education.				

Quantum Computing					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to quantum computing				8
Unit 2	Relevant Linear algebra for quantum computing, Postulates of quantum mechanics,				10
Unit 3	Classical computing, Quantum circuits, Quantum Fourier Transform				10
Unit 4	Quantum search algorithms, Physical realization of quantum computers.				8
Unit 5	Quantum noise, Quantum operations, quantum information and quantum channel				6
References:					
1.	Pittenger A. O., An Introduction to Quantum Computing Algorithms				
2.	Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.				
3.	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.				

Quantum Cryptography					
Prerequisite:		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and Entropy.				8
Unit 2	Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain, Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block-Size Selection, Fixed Initial Block-Size, Dynamic Initial BlockSize.				10
Unit 3	Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment, Individual Attacks in an Realistic Environment. QKD Systems, Statistical Analysis of QKD Networks in Real-Life Environment: Statistical Methods, Results of the Experiments, Statistical Analysis.				10
Unit 4	QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. QuantumCryptographic Networks from a Prototype to the Citizen.				8
Unit 5	The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust.				6
References:					
1.	Quantum Cryptography and Secret-Key Distillation, Gilles van Assche, Cambridge University Press, 2006.				
2.	Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007).				
3.	Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2000).				

Real Time Systems					
Prerequisite: None		L	T	P	C
Total hours: 40		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction : Definition, Typical Real Time Applications; Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency				7
Unit 2	Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-SlackTime-First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems				8
Unit 3	Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Nonpreemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in MultipleUnit Resources, Controlling Concurrent Accesses to Data Objects				8
Unit 4	Multiprocessor System Environment :Multiprocessor and Distributed System Model, Multiprocessor Priority-Ceiling Protocol, Schedulability of FixedPriority End-to-End Periodic Tasks, Scheduling Algorithms for End-to-End Periodic Tasks, Endto-End Tasks in Heterogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints.				9
Unit 5	Real Time Communication : Model of Real Time Communication, Soft and Hard RTCommunication systems , Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols forBroadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System. An Overview of Real Time Operating Systems and Databases: Features of RTOS, UNIX as RTOS, POSIX Issues, Temporal Consistency, Concurrency Control.				8
References:					
1.	Real Time Systems: Theory and Practice – Mall Rajib, Pearson Education, 2009				
2.	Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley, 2002.				
3.	H. Kopetz, "Real time systems: Design Principles for distributed embedded applications", Springer Publications, 2011.				
4.	Douglass, Real Time UML: Advances in the UML for Real-Time Systems, 3/e, AddisonWesley, 2004.				
5.	Awad, Kuusela& Ziegler, Object-Oriented Technology for Real Time Systems: A Practical Approach Using OMT and Fusion, l/e, Pearson Education, 1996.				
6.	Ward & Mellor, Structured Development for Real-Time Systems, Vol. III: Implementation Modeling Techniques, Prentice Hall, 1986.				

Robotics and Control					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction to robotics-origin of automation, Classification of robots, Rotations and translation of vectors.				8
Unit 2	Transformations and Euler angle representations, Homogeneous transformations, Problems, Trajectory planning.				10
Unit 3	Actuators, Velocity and position sensors. Range, proximity, touch sensors.				10
Unit 4	Control of Robot Manipulators: PD control, Nonlinear Control, Stability, Lyapunov's Direct Method.				8
Unit 5	Adaptive Control, Robot Vision, Image segmentation, Template matching, Polyhedral objects, Shape analysis, Grasping and industrial automation.				6
References:					
1.	M. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control Wiley (2006)				
2.	Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications",				
3.	Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999				
4.	Nagrath Gopal "Control Systems Engineering -Principles and Design" New Age Publishers				
5.	K. Ogata, "Modern control engineering", Pearson 2002.				

Security Analysis of Protocols					
Prerequisite:		L	T	P	C
Total hours: 40		3	0	0	3
Course Content					Hrs.
Unit 1	Cryptographic background; Authentication, Key establishment and IP security;				8
Unit 2	Denial of service; Anonymity and MIX networks; Fairness and contract signing, Privacy and protection of individual information; Wireless security (mobile phones, WiFi);				12
Unit 3	Protocol analysis tools: Finite-state checking; Infinite-state symbolic analysis; Probabilistic model checking; Game-based verification; Process algebras (spi-calculus and applied pi calculus); Protocol logics (BAN, DDMP, Isabelle);				12
Unit 4	Introduction to Probabilistic polynomial time calculus; Relating cryptographic and formal models.				8
References:					
1.	Latest reputed conference and journal articles as chosen by the instructor.				
2.	Maximum Security, 2nd Edition, SAMS Books by Anonymous, 1998				
3.	Maximum Linux Security, SAMS Books by Anonymous, 2000, ISBN: 0-672- 31670-6.				
4.	10 Risks of PKI: What You're not Being Told about Public Key Infrastructure, by Ellison and Schneier				

Selected Topics in Cryptography					
Prerequisite:		L	T	P	C
Total hours: 40		3	0	0	3
Course Content					Hrs.
Unit 1	Basic Concepts: Information theoretic vs. computational security. One way functions, Pseudo randomness generators and functions, Permutations, hash functions.				8
Unit 2	Private-key encryption using pseudo randomness. Private-key authentication. – Public key encryption (and number theory). Public key authentication.				12
Unit 3	Interactive protocols: Touch of complexity theory, Interactive proof systems; 0knowledge proof systems,0-knowledge authentication, Electronic cash; noninteractive zero-knowledge.				12
Unit 4	Oblivious transfer: Definitions, constructions, and applications, Secure Multiparty computations, Database (differential) privacy. – Proofs of work – Block-chain consensus protocols.				8
References:					
1.	Introduction to Modern Cryptography: Principles and Protocols, by Jonathan Katz and Yehuda Lindell				
2.	A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup				
3.	The Joy of Cryptography by Mike Rosulek.				
4.	OdedGoldreich: Foundations of Cryptography Vol 1 and Vol 2				

Social Media Mining					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Online Social Networks (OSNs): Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data.				8
Unit 2	Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data.				10
Unit 3	Characteristics of OSNs: Information Diffusion, Experimental studies over OSNs, Sampling, Fundamentals of Social Data Analytics: Topic Models, Random Walks, Heterogeneous Information Networks				10
Unit 4	Applied Social Data Analytics: Recommendation Systems, Community identification and link prediction.				8
Unit 5	Advanced Topics: Online experiments for Computational Social Science, Big Data Sampling				6
References:					
1.	Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media				
2.	Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann				
3.	Charu Aggarwal (ed.), Social Network Data Analytics, Springer				
4.	Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Social Media Mining An Introduction, Cambridge University Press				

Software Project Management					
Prerequisite: Software Engineering, Computer Programming (C/Java/Python/C++), Microsoft Excel		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Software Project Concepts: Software Project Categorization, Stakeholders, Software project Activities, Practices & Standards, Selecting Process Models (Spiral, Incremental, Prototyping, RAD, Agile).				8
Unit 2	Estimation & Evaluation techniques,Cost Benefit Analysis, Risk Analysis for Project Evaluation, Program management, Project effort and cost estimation; Basis of estimation, Estimation method categorization, SLOC, Function Point Analysis, COCOMO, Putnam's work. Estimation using FP.				10
Unit 3	Project Planning: Stepwise planning, Activity based approach (WBS), Sequencing and Scheduling of Activities, Critical Path Method. Risk Analysis and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management Schedule and Cost Monitoring: Collecting Data & Reporting, Graphical Visualization techniques, Cost Monitoring, Earned Value analysis, Requirements management, Change Control.				10
Unit 4	Contract Management: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Management and Acceptance.				6
Unit 5	Software Configuration Management (SCM), SCM Tools, Project Reviews Testing and Software Reliability, Metrics, ISO and CMMI, Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management				8
References:					
1.	Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata McGraw Hill, 2017.				
2.	Pankaj Jalote, Software Project Management in Practice.				
3.	Roger S. Pressman, Software Engineering				
4.	Royce, "Software Project Management", Pearson Education, 1999.				
5.	Robert K. Wysocki, Effective Software Project Management, Wiley, 2009.				

System on Chip					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Transaction-Level Modeling& Electronic System-Level Languages,				8
Unit 2	Hardware Accelerators, Media Instructions, Co-processors				10
Unit 3	System-Level Design Methodology ,High-Level Synthesis (Cto-RTL),				10
Unit 4	Hardware Synthesis and Architecture Techniques Source-Level Optimizations.				8
Unit 5	Scheduling Resource, Binding and Sharing.				6
References:					
1.	De Micheli, editor Special Issue on Hardware/Software Co-design Proceedings of IEEE, Vol 85, No. 3, March 1997				
2.	D. D. Gajski, F. Vahid, S. Narayan, J. Gong :Specification and Design of Embedded Systems, Prentice Hall, Englewood Cliffs, NJ, 1994				
3.	J. Staunstrup and W. Wolf, editors: Hardware/Software Co-Design: Principles and Practice Kluwer Academic Publishers, 1997				
4.	G. DeMicheli, R. Ernst, and W. Wolf, editors, Readings in Hardware/Software Co-Design, Academic Press, 2002.				

Wireless Sensor Networks					
Prerequisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Introduction: Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks/sensor network, data dissemination and gathering, Historical Survey of Sensor Networks				8
Unit 2	Basic Architectural Framework:Traditional layered stack, Cross-layer designs, Sensor network architecture, Physical Layer, Basic Components, Hardware Platforms: Motes, Sensor Devices, Types of Sensors, Sensor's Specification				8
Unit 3	MAC Protocols : Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention Based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.				12
Unit 4	Sensor network security: Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management.				8
Unit 5	Secure Routing – SPINS, reliability requirements in sensor networks. Programming in WSNs: Challenges and limitations of programming WSNs, Introduction to TinyOS, - Programming in Tiny OS using NesC, Emulator TOSSIM, Open research issues				6
References:					
1.	Feng Zhao, Leonidas Guibas, " Wireless Sensor Network", Elsevier, 1st Ed. 2004 (ISBN: 13-978-1-55860-914-3)				
2.	Kazem, Sohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).				
3.	Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).				
4.	E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press , 2009				