

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

Group 1		
Sl. No.	Course Code	Course
1	16SFC151	Access Control and Identity Management System
2	16SCE12	Advanced Digital Design
3	16SCS242	Agile Technologies
4	16SCE154 / 16SCS244 / 16SFC251 / 16SIT23 / 16SSE241	Data Mining & Data Warehousing
5	16SCN331	Analysis of Computer Networks
6	16LNI31 / 16SIT151	Client Server Programming
7	18SCS153 / 18SIT13	Data Compression
8	16SIT152	Information storage Management
9	16LNI12/16SCN13/16SCS253	Information and Network Security
10	16LNI22 / 16SCE23 / 16SCN14 / 16SCS14 / 16SSE321	Internet of Things
11	16LNI334 / 16SCN322	Network Routing Algorithm
12	16SFC324	Security Assessment and Verification
13	16LNI23 / 16SCN332	Protocol Engineering
14	16SCE242	Pattern Recognition

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Group 2		
Sl. No.	Course Code	Course
1	16LNI23 / 16SCN332	Advanced Cryptography
2	16LNI243 / 16SCE323 / 16SCN241 / 16SCS241 / 16SIT253 / 16SSE153	Advances in Storage Area Network
3	16SCE151	Computer Systems Performance Analysis
4	16SCS12	Advances in Operating Systems
5	16SFC242	Biometric Security
6	16LNI244 / 16SCE244 / 16SIT244 / 16SCS334	Cyber Security and Cyber law
7	16SFC12	Ethical Hacking
8	16SFC31	File System Forensic Analysis
9	16SSE252	Information Retrieval
10	16LNI152 / 16SCE322 / 16SCN21	Multimedia Communications
11	16SFC13	Pragmatic of Information Security
12	16SFC21	Preserving and Recovering Digital Evidence
13	16SCE334 / 16SIT333 / 16SSE13	Object Oriented Software Engineering

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Group 3		
Sl. No.	Course Code	Course
1	16SCE153	Advances in Computer Architecture
2	16SFC154 / 16SCS331	Application and Web Security
3	16SCS254	Advances in Digital Image Processing
4	16SCE31	ARM Processors
5	16LNI251 / 16SCE21 / 16SCN252 / 16SCS21 / 16SFC331 / 16SIT31 / 16SSE322	Managing Big Data
6	16LNI153 / 16SCN243	Ethernet Technology
7	16SCE253	Decision Support System
8	16SCE154 / 16SIT154 / 16SSE152	Distributed Operating System
9	16SFC323	Mobile Device Forensics
10	16LNI13	Network Programming
11	16LNI21	Network Protocol Design
12	16LNI11	Semantic Web and Social Networks
13	16SIT321 / 16SSE324	Supply Chain Management

Group 4		
Sl. No.	Course Code	Course
1	16SCS251/ 16SIT251	Advances in Computer Graphics
2	16SCE252 / 16SCS13 / 16SIT14 / 16SSE151	Advances in Data Base Management System
3	16SSE12	Advances in Software Testing
4	16LNI151 / 16SCE14 / 16SCN31 / 16SCS23 / 16SIT22 / 16SSE251	Cloud Computing
5	16SCE13 / 16SCS152	Embedded Computing Systems
6	16SFC13	Cyber Crime and Cyber Forensics
7	16SFC241	Cyber Laws and Ethics
8	16SCN323/16SFC243	Information Security Policies in Industry
9	16LNI154 /16SCN253	Network Management
10	16SCE243 /16SCS333	Natural Language Processing and Text Mining
11	16LNI323/16SCN244/16SFC332 / 16SIT241	Mobile Application Development
12	16SFC321	Security Architecture Design
13	16LNI252	Software Agents
14	16SCE333	Software Defined Networks

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Group 5		
Sl. No.	Course Code	Course
1	16SCS22/16SSE244	Advanced Algorithms
2	16LNI321 / 16SCN12 / 16SCS151	Advances in Computer Networks
3	16SCS243 / 16SIT252	Business Intelligence and its Applications
4	16SCE332 / 16SFC252	Database Security
5	16LNI253 / 16SIT242	Bioinformatics
6	16SCE254	Computer Vision
7	16SFC253 / 16SIT12 / 16SSE22 / 16SCS324	Enterprise Application Programming
8	16SCE22 / 16SCN152 / 16SCS152	Multi Core Architecture and Programming
9	16LNI322 / 16SCE321 / 16SCN324 / 16SCS31 / 16SFC254 / 16SIT322 / 16SSE334	Machine Learning Techniques
10	16LNI333 / 16SCE331 / 16SCN154 / 16SFC152	Cloud Security
11	16SFC22	Operating System Security
12	16LNI332 / 16SCN153 / 16SFC333	Social Network Analysis
13	16SIT153 / 16SSE14	Service Oriented Architecture
14	16SFC23	Secured Programming

Group 6		
Sl. No.	Course Code	Course
1	16LNI331 / 16SCE241 / 16SCN151 / 16SCS323	Wireless Networks & Mobile Computing
2	16SCN424	Web Mining
3	16SCN333 / 16SIT324	Web Engineering
4	16LNI324 / 16SCE251 / 16SCN251	Wireless Sensor Networks
5	16SCN242	Switching & Statistical Multiplexing In Telecommunications
6	16LNI242 / 16SIT21 / 16SSE154	Web Services
7	16LNI241 / 16SCN23	Wireless Ad hoc Networks
8	16SFC322	Steganography and Digital Watermarking
9	16SSE21/ 16SCS332	Software Project Planning & Management
10	16SFC334 / 16SIT243 / 16SSE242	Software Metrics & Quality Assurance
11	16SFC244 / 16SSE253	Trust Management in E-commerce
12	16SSC23	Software Design Patterns
13	16SCS252 / 16SIT323 / 16SSE254	Trends in Artificial Intelligence and Soft Computing
14	16SSE41	Soft Computing

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01	16SFC151	Group-1	ACCESS CONTROL AND IDENTITY MANAGEMENT SYSTEM
Exam Hours:03		Exam Marks:100	
Module -1 Access control: Introduction, Attenuation of privileges, Trust and Assurance, Confinement problem, Security design principles, Identity Management models, local, Network, federal , global web identity, XNS approach for global Web identity, Centralized enterprise level Identity Management.			
Module -2 Elements of trust paradigms in computing, Third party approach to identity trust, Kerberos, Explicit third party authentication paradigm, PKI approach to trust establishment, Attribute certificates, Generalized web of trust models, Examples.			
Module -3 Mandatory access control, comparing information flow in BLP and BIBA models, Combining the BLP and BIBA models, Chinese wall problem.			
Module -4 Discretionary access control and Access matrix model, definitions, Safety problem, The take grant protection model, Schematic protection model, SPM rules and operations, Attenuating, Applications			
Module -5 Role based access control, Hierarchical Access Control, Mapping of a mandatory policy to RBAC, Mapping discretionary control to RBAC, RBAC flow analysis, Separation of Duty in RBAC, RBAC consistency properties, The privileges perspective of separation of duties, Functional specification for RBAC.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Messoud Benantar, “Access Control Systems: Security, Identity 2. Management and Trust Models”, Springer, 2009. 			
Reference Books: <ol style="list-style-type: none"> 1. Elena Ferrari and M. Tamer A-zsu , “Access Control In Data Management 2. Systems”, Morgan & Claypool Publishers, 2010. 			

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02	16SCE12	Group-1	ADVANCED DIGITAL DESIGN
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Design methodology – An introduction; IC technology options			
Module -2 Logic Design with Verilog: Structural models of combinational logic; Logic simulation, Design verification, and Test methodology; Propagation delay; Truth-Table models of Combinational and sequential logic with Verilog.			
Module -3 Logic Design with Behavioral Models: Behavioral modeling; A brief look at data types for behavioral modeling; Boolean-Equation – Based behavioral models of combinational logic; Propagation delay and continuous assignments; Latches and Level – Sensitive circuits in Verilog; Cyclic behavioral models of Flip-Flops and Latches; Cyclic behavior and edge detection; A comparison of styles for behavioral modeling; Behavioral models of multiplexers, encoders, and decoders; Dataflow models of a Linear- Feedback Shift Register; Modeling digital machines with repetitive algorithms; Machines with multi-cycle operations; Design documentation with functions and tasks; Algorithmic state machine charts for behavioral modeling; ASMD charts; Behavioral models of counters, shift registers and register files; Switch debounce, meta-stability and synchronizers for asynchronous signals; Design example			
Module -4 Synthesis of Combinational and Sequential Logic: Introduction to synthesis; Synthesis of combinational logic; Synthesis of sequential logic with latches; Synthesis of three-state devices and bus interfaces; Synthesis of sequential logic with flip-flops; Synthesis of explicit state machines; Registered logic; State encoding; Synthesis of implicit state machines, registers and counters; Resets; Synthesis of gated clocks and clock enables; Anticipating the results of synthesis; Synthesis of loops; Design traps to avoid; Divide and conquer: Partitioning a design.			
Module -5 Programmable Logic and Storage Devices: Programmable logic devices; storage devices; PLA; PAL; Programmability of PLDs; CPLDs; FPGAs; Verlog-Based design flows for FPGAs; Synthesis with FPGAs.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Michael D. Celetti: Advanced Digital Design with the Verilog HDL, PHI, 2013			
Reference Books: 1. PeterJ. Asheden: Degital Design –An Embedded Systems Approach Using VERILOG, ELSEVIER 2013. 2. Stephen Brown, Zvonko Vranesic: Fundamentals of Digital Logic with Verilog Design, Tata Mc-Graw Hill 2009.			

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03	16SCS242	Group-1	AGILE TECHNOLOGIES
Exam Hours:03		Exam Marks:100	
Module -1 Why Agile?: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile?: Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor			
Module -2 Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us?, Go!, Assess Your Agility			
Module -3 Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting, Releasing: “Done Done”, No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation. Planning: Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. Developing: Incremental requirements, Customer Tests, Test- Driven Development, Refactoring, Simple Design ,Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing			
Module -4 Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People : Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, Eliminate Waste : Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput			
Module -5 Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence : Software Doesn't Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. The Art of Agile Development (Pragmatic guide to agile software development), James shore, Chromatic, O'Reilly Media, Shroff Publishers & Distributors, 2007			
Reference Books: 1. Agile Software Development, Principles, Patterns, and Practices, Robert C. Martin, Prentice Hall; 1st edition, 2002 2. Agile and Iterative Development A Manger's Guide”, Craig Larman Pearson Education, First Edition, India, 2004			

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04	16SCS244	Group-1	DATA MINING & DATA WAREHOUSING
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction and Data Preprocessing :Why data mining, What is data mining, What kinds of data can be mined, What kinds of patterns can be mined, Which Technologies Are used, Which kinds of Applications are targeted, Major issues in data mining .Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization.</p>			
<p>Module -2 Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation, Data generalization by attribute-oriented induction,</p>			
<p>Module -3 Classification: Basic Concepts: Basic Concepts, Decision tree induction, Bays Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy</p>			
<p>Module -4 Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering.</p>			
<p>Module -5 Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. 			

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- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining Concepts and Techniques, ELSEVIER(MK) 3rd edition 2012.

05	16SCN331	Group-1	ANALYSIS OF COMPUTER NETWORKS
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction: Two examples of analysis: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; the importance of quantitative modeling in the Engineering of Telecommunication Networks.			
Module -2			
Multiplexing: Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.			
Module -3			
Stream Sessions: Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling (continued).			
Module -4			
Stream Sessions: Stochastic Analysis: Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little's theorem, Brumelle's theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range- Dependent traffic			
Module -5			
Adaptive Bandwidth Sharing for Elastic Traffic: Elastic transfers in a Network; Network parameters and performance objectives; sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet's Adaptive Window Protocol; Bandwidth sharing in a Network.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. 			

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- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. AnuragKumar, D.Manjunath, Joy Kuri:CommunicationNetworking An AnalyticalApproach, Elsevier,2004.

Reference Books:

1. M. Schwartz: Broadband Integrated Networks, Prentice Hall PTR, 1996.

2. J. Walrand, P. Varaiya: High PerformanceCommunication Networks, 2nd Edition, Morgan Kaufmann,1999

06	16LN131	Group-1	CLIENT SERVER PROGRAMMING
Exam Hours:03		Exam Marks:100	
<p>Module -1 The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts. Concurrent Processing in Client-Server software: Introduction, Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design, Concurrency and Asynchronous I/O. Program Interface to Protocols: Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIX I/O with TCP/IP.</p>			
<p>Module -2 The Socket Interface: Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in a Program, Symbolic Constants for Socket Call Parameters. Algorithms and Issues in Client Software Design: Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by Name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability.</p>			
<p>Module -3 Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service, A UDP</p>			

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Client for the ECHO Service.
Module -4 Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs Iterative Servers, Connection-Oriented Vs Connectionless Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations.
Module -5 Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server. Iterative, Connection-Oriented Servers (TCP): Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability. Concurrent, Connection-Oriented Servers (TCP): Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes.
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.
Text Books: 1. Douglas E.Comer, David L. Stevens: Internetworking with TCP/IP – Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSI C, 2nd Edition, Pearson, 2001.

07	16SCS153	Group-1	DATA COMPRESSION
Exam Hours:03	Exam Marks:100		
Module -1 Introduction: Compression techniques, modeling and coding mathematical preliminaries for lossless compression: A brief introduction to information theory, models, coding, algorithmic information theory, minimum description length principle.			
Module -2 Huffman Coding: The Huffman coding algorithm, non binary Huffman codes, adaptive Huffman coding, golomb codes, rice codes, Tunstall codes, application of Huffman coding.			
Module -3 Lossless Image Compression: Introduction, CALIC, JPEG-LS, multi resolution approaches, facsimile encoding, MRC-T.44. Mathematical Preliminaries For Lossy Coding: Introduction, distortion criteria, information theory revisited, rate distortion theory, models			
Module -4 Wavelet Based Compression: Introduction, wavelets, multi resolution analysis and scaling function, implementation using filters, image compression, embedded zero tree coder, set partitioning in hierarchical trees, JPEG zero. Audio Coding: Introduction , MPEG coding, MPEG advanced audio coding, Dolby AC3(DOLBY DIGITAL) other standards.			
Module -5 Video Compression: Introduction, motion compensation, video signal representation, ITU-T recommendation H.261, model based coding, asymmetric applications, The MPEG-1 video standard, The MPEG-2 video standard, ITU-T recommendation H.263, ITU-T recommendation H.264, MPEG-4 part 1.0 advanced video coding, MPEG-4 part 2 , packet video, ATM networks.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. 			

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| <ul style="list-style-type: none">• There will be 2 full questions (with a maximum of four sub questions) from each module.• Each full question will have sub questions covering all the topics under a module.• The students will have to answer 5 full questions, selecting one full question from each module. |
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Text Books:

1. Introduction to data compression 4th edition, Khalid sayood. <i>Elsevier</i> . Reprinted 2014.

Reference Books:

1. Data compression, The complete reference. 4th edition. David Salomon. Springer Year 2014.
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08	16SIT152	Group-1	INFORMATION STORAGE MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1			
<p>Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data center Infrastructure, Virtualization and cloud computing. Data Center Environment: Application, Database Management System(DBMS), Host(compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based On Application, Disk Native Command Queuing, Introduction to Flash Drives, Concept in Practice: VMware ESXi. Data Protection: RAID: RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares.</p>			
Module -2			
<p>Intelligent Storage Systems: Components of an Intelligent Storage System, Storage Provisioning, Types of intelligent Storage Systems, Concepts in Practice: EMC Symmetrix and VNX. Fiber Channel Storage Area Networks: Fiber Channel: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fiber Channel Architecture, fabric Services, Switched fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN, Concepts in Practice: EMC Connectrix and EMC VPLEX. IP SAN and FcoE: iSCSI, FCIP, FcoE.</p>			
Module -3			
<p>Network-Attached Storage: General-purpose Servers versus NAS Devices, benefits of NAS, File Systems and network File Sharing. Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, factors Affecting NAS Performance, File-Level Virtualization, Concepts in Practice: EMC Isilon and EMC VNX gateway. Object-Based and unified Storage: Object-Based Storage Devices, Content-Addressed Storage, CAS use Cases, unified Storage, Concepts in Practice: EMC atoms, EMC VNX, and EMC centera. Introduction to Business Continuity. Information Availability, BC Terminology, BC Planning life Cycle, failure Analysis, Business Impact Analysis, BC Technology solutions.</p>			
Module -4			
<p>Backup and Archive : Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operation, Backup Topologies, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive ,Archiving Solution Architecture, Concepts in Practice :EMC Networker, EMC Avamar, and EMC Data domain. Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas, Local Replication in Virtualized Environment, Concepts in Practice: EMC TimeFinder. Remote Replication: Modes of Remote Replication, Remote Replication Technologies, Three-Site Replication, Data Migration Solutions, Remote Replication and Migration in a Virtualized Environment, Concepts in Practice : EMC SRDF, EMC MirrorView, and EMC RecoverPoint.</p>			
Module -5 Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Security implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments, Concepts in practice: RSA and VMware Security Products. Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Idea Solution, Information Lifecycle Management, Storage Tiering, Concepts in Practice: EMC Infrastructure.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. EMC2 : Information Storage and Management, Willey India 2013.			
Reference Books:			
1. EMC Corporation, Information Storage and Management, Wiley, India. ISBN-13: 978-8126537501, August 2012.			
2. Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill , Osborne, 2003.			
3. Marc Farley, “Building Storage Networks”, Tata McGraw Hill ,Osborne, 2001.			
4. Additional resource material on www.emc.com/resource-library/resource-library.esp			

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09	16LNI12/16SCN13/1 6SCS253	Group-1	INFORMATION AND NETWORK SECURITY
Exam Hours:03		Exam Marks:100	
Module -1			
<p>Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.</p>			
Module -2			
<p>Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffie-hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Z_p, elliptic curves over $GF(2^m)$, Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA.</p>			
Module -3			
<p>Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, public key infrastructure. User Authentication: Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication, federated identity management, identity management, identity federation, personal identity verification.</p>			
Module -4			
<p>Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE 802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE 802 protocol architecture. Security, IEEE 802.11i services, IEEE 802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase, the IEEE 802.11i pseudorandom function. Web Security Considerations: Web Security Threats, Web Traffic Security Approaches. Secure Sockets Layer: SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. Transport Layer Security: Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. HTTPS Connection Initiation, Connection Closure. Secure Shell(SSH) Transport Layer Protocol, User Authentication Protocol, Connection Protocol</p>			
Module -5			
<p>Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. IP Security: IP Security overview, applications of IPsec, benefits of IPsec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Anti replay service, transport and tunnel modes, combining security associations, authentication plus confidentiality, basic combinations of security associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits.</p>			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. 			

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| <ul style="list-style-type: none">• Each full question consists of 20 marks.• There will be 2 full questions (with a maximum of four sub questions) from each module.• Each full question will have sub questions covering all the topics under a module.• The students will have to answer 5 full questions, selecting one full question from each module. |
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Text Books:

1. William Stallings, Cryptography and Network Security, Pearson 6th edition.

Reference Books:

1. V K Pachghare: Cryptography and Information Security.
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10	16SCS14	Group-1	INTERNET OF THINGS
Exam Hours:03		Exam Marks:100	
<p>Module -1 What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples- Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.</p>			
<p>Module -2 Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards- Overview and Approaches,IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol,Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Lowpower WPAN, Zigbee IP(ZIP),IPSO</p>			
<p>Module -3 Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3Connectivity :IPV6 Technologies for the IoT:Overview and Motivations. Address Capabilities,IPV6 Protocol Overview, IPV6 Tunneling, IPsec in IPV6,Header Compression Schemes,Quality of Service in IPV6, Migration Strategies to IPV6.</p>			
<p>Module -4 Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.</p>			
<p>Module -5 Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M communications", Wiley, 2013. 2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands on Approach" Universities Press., 2015 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Michael Miller," The Internet of Things", First Edition, Pearson, 2015. 2. Claire Rowland,Elizabeth Goodman et.al.," Designing Connected Products", First Edition,O'Reilly, 2015. 			

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As per 2017 Regulation

11	16SCN322	Group-1	NETWORK ROUTING ALGORITHMS
Exam Hours:03		Exam Marks:100	
<p>Module -1 NETWORK ROUTING: BASICS AND FOUNDATIONS: Networking and Network Routing: An Introduction: Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture, Network Management Architecture, Public Switched Telephone Network, Communication Technologies, Standards Committees, Last Two Bits. Routing Algorithms: Shortest Path and Widest Path: Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra’s Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra’s Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm Routing Protocols: Framework and Principles: Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol, Link Cost</p>			
<p>Module -2 ROUTING IN IP NETWORKS: IP Routing and Distance Vector Protocol Family : Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol, Version 1 (RIPv1), Routing Information Protocol, Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution OSPF and Integrated IS-IS :From a Protocol Family to an Instance of a Protocol, OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS, Similarities and Differences Between IS-IS and OSPF Internet Routing Architectures: Internet Routing Evolution, Addressing and Routing: Illustrations, Current Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability</p>			
<p>Module -3 Router Architectures: Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures. IP Address Lookup Algorithms: Impact of Addressing on Lookup, Longest Prefix Matching, Naïve Algorithms, Binary Tries, Multibit Tries, Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches. IP Packet Filtering and Classification: Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for Two Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions.</p>			
<p>Module -4 ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS: Wireless networking basic aspects, Basic routing concepts, Ad hoc routing, Mesh routing, Vehicular routing, Sensor routing</p>			
<p>Module -5 TOWARD NEXT GENERATION ROUTING: Quality of Service Routing: QoS Attributes, Adapting Shortest Path and Widest Path Routing: A Basic Framework, Update Frequency, Information Inaccuracy, and Impact on Routing, Lessons from Dynamic Call Routing in the Telephone Network, Heterogeneous Service, Single-Link Case, A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing MPLS and GMPLS: Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching, Generalized MPLS, MPLS Virtual Private Networks. Routing and Traffic Engineering with MPLS: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Routing/Traffic Engineering for Voice Over MPLS. VoIP Routing: Interoperability through IP and PSTN : PSTN Call Routing Using the Internet, PSTN Call Routing: Managed IP Approach, IP-PSTN Interworking for VoIP, IP Multimedia Subsystem, Multiple Heterogeneous Providers Environment and All-IP Environment of VoIP Services.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> The question paper will have ten questions. 			

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- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Deepankar Medhi and Karthikeyan Ramasamy, “Network Routing: Algorithms, Protocols, and Architectures”, (The Morgan Kaufmann Series in Networking), Elsevier Inc 2007
2. Miguel Elias M. Campista and Marcelo G. Rubinstein, “Advanced Routing Protocols for Wireless Networks”, John Wiley & Sons, Inc, © ISTE Ltd 2014

Reference Books:

1. William Stallings, “High speed networks and Internets Performance and Quality of Service”, 2nd Edition, Pearson Education Asia. Reprint India 2002.
2. M. Steen Strub, “Routing in Communication network,” Prentice –Hall International, Newyork, 1995.
3. James D. McCabe, “Network Analysis, Architecture, and Design”, 3rd Edition, 2007 Elsevier Inc.

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12	16SFC324	Group-1	SECURITY ASSESSMENT AND VERIFICATION
Exam Hours:03		Exam Marks:100	
Module -1 Evolution of information security: information assets, security standards, organizational impacts, security certifications, elements of information security program, need for security assessment, security assessment process.			
Module -2 Security assessment planning: Business drivers, scope definition, consultant’s perspective, Client’s perspective, Development of project plan. Initial information gathering, Initial preparation, analysis of gathered information.			
Module -3 Business process evaluation, Technology evaluation, Risk analysis, Risk mitigation.			
Module -4 Security Risk assessment project management, Security risk assessment approaches and methods.			
Module -5 Information security standards, Information security Legislation, Formal security verification, Security verification with SSL.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books <ol style="list-style-type: none"> 1. Sudhanshu Kairab, A practical guide to security assessments, CRC press, 2005. 2. Douglas J. Landoll, A Security risk assessment Handbook, Auerbach publications, 2006. 			
Reference Books: <ol style="list-style-type: none"> 1. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, 2nd Edition, Cengage Learning Pub. 2. Thomas R Peltier, Justin Peltier and John Blackley, "Information Security Fundamentals", 2nd Edition, Prentice Hall, 1996 			

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13	16SCN332	Group-1	PROTOCOL ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Communication Model, Communication Software, Communication Subsystems, Communication Protocol, Communication Protocol Development Methods, Protocol Engineering Process. Layered Architecture, Network Services and Interfaces, Protocol Function, OSI Model, TCP/IP Protocol Suite, Application Protocols, Protocol Specification: Components of Protocol to be Specified, Communication Service Specification, Protocol Entity Specification, Interface Specifications, Multimedia Protocol Specifications, Internet Protocol Specifications: Examples			
Module -2 SDL: Examples of SDL Based Protocol Specifications Introduction to Other Protocol Specification Languages.			
Module -3 Protocol Verification/Validation: Protocol Verification, Verification of a Protocol Using Finite State Machines, Protocol Validation, Protocol Design Errors, Protocol Validation Approaches, and SDL based Protocol Verification, SDL based Protocol Validation			
Module -4 Protocol Conformance Testing: Conformance Testing, Conformance Testing Methodology and Framework, conformance Test Architectures, Test Sequence Generation Methods, Distributed Architecture by Local Methods, Conformance Testing with TTCN, Conformance Testing in Systems with Semi-controllable Interfaces, Conformance Testing of RIP, Multimedia Applications Testing, SDL Based Tools for Conformance Testing, SDL Based Conformance Testing of MPLS.			
Module -5 Protocol Synthesis: Protocol Synthesis, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis. Protocol Implementation: Requirements of Protocol Implementation, Object based approach to Protocol Implementation, Protocol Compilers, and Tools for Protocol Engineering.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Venkataram & Manvi, Pallapa Venkataram Sunilkumar S. Manvi, "Communication Protocol Engineering", PHI Learning Pvt. Ltd., 2004.			
Reference Books: 1. Miroslav Popovic, "Communication Protocol Engineering", CRC Press, 2006. 2. Konig, Hartmut, "Protocol Engineering", Springer, 2012.			

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14	16SCE242	Group-1	PATTERN RECOGNITION
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems			
Module -2 Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation			
Module -3 Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayessian belief network			
Module -4 Naive Bayes classifier, Bayessian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM			
Module -5 Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Pattern Recognition (An Introduction) , V Susheela Devi, M Narsimha Murthy, 2011 Universities Press, ISBN 978-81-7371-725-3			
2. Pattern Recognition & Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost. PH ISBN-81-203-1484-0, 1996.			
Reference Books:			
1. Duda R. O., P.E. Hart, D.G. Stork., Pattern Classification, John Wiley and sons, 2000.			

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01	16LNI23 / 16SCN332	Group-2	ADVANCED CRYPTOGRAPHY
Exam Hours:03		Exam Marks:100	
Module -1 OSI security architecture: Classical encryption techniques, Cipher principles, Data encryption standard, Block cipher design principles and modes of operation, Evaluation criteria for AES, AES cipher, Triple DES, Placement of encryption function, Traffic confidentiality.			
Module -2 Key management: Diffie Hellman key exchange, Elliptic curve architecture and cryptography, Introduction to number theory, Confidentiality using symmetric encryption, Public key cryptography and RSA.			
Module -3 Authentication requirements: Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MACS, MD5 Message Digest algorithm, Secure hash algorithm, Ripend, HMAC digital signatures, Authentication protocols.			
Module -4 Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. non local interactions, entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments.			
Module -5 Future trends: Review of recent experimental achievements, study on technological feasibility of a quantum computer candidate physical systems and limitations imposed by noise.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. William Stallings, "Cryptography and Network Security -Principles and Practices", 3rd Edition, Prentice Hall of India, 2003. 2. Atul Kahate, "Cryptography and Network Security", Tata McGraw -Hill, 2003. 3. William Stallings, "Network Security Essentials: Applications and Standards", Pearson Education Asia, 2000. 			
Reference Books: <ol style="list-style-type: none"> 1. R. P. Feynman, "Feynman lectures on computation", Penguin Books, 1996. 2. Gennady P. Berman, Gary D. Doolen, Ronnie Mainiri & Valdmis Itri Frinovich, "Introduction to quantum computers", World Scientific, Singapore, 1998. 3. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography" Principles And Protocols",CRC Press. 			

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02	16SCS241	Group-2	ADVANCES IN STORAGE AREA NETWORK
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.			
Module -2 I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.			
Module -3 Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.			
Module -4 SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.			
Module -5 Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India,2013.			
Reference Books: 1. Robert Spalding: “Storage Networks The Complete Reference”, Tata McGraw-Hill, 2011. 2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005. 3. Richard Barker and Paul Massiglia: “Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs”, Wiley India, 2006.			

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03	16SCS151	Group-2	COMPUTER SYSTEMS PERFORMANCE ANALYSIS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.			
Module -2 Workloads, Workload Selection and Characterization: Types of Workloads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.			
Module -3 Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.			
Module -4 Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote- Terminal Emulation; Components of an RTE; Limitations of RTEs. Experimental Design and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.			
Module -5 Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2013.			
Reference Books: 1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, Elsevier, 2003. 2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India, 2001.			

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04	16SCS12	Group-2	ADVANCES IN OPERATING SYSTEMS
Exam Hours:03		Exam Marks:100	
Module -1. Operating System Overview, Process description & Control: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems, What is a Process?, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues.			
Module -2 Threads, SMP, and Microkernel, Virtual Memory: Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX Memory Management, Windows Vista Memory Management, Summary			
Module -3 Multiprocessor and Real-Time Scheduling: Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSI) Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock			
Module -4 Embedded Operating Systems: Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits.			
Module -5 Kernel Organization: Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine , Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management,Running Process Manager, Creating a new Task , IPC and Synchronization, The Scheduler , Memory Manager , The Virtual Address Space, The Page Fault Handler , File Management. The windows NT/2000/XP kernel: Introduction, The NT kernel, Objects , Threads, Multiplication Synchronization,Traps,Interrupts and Exceptions, The NT executive , Object Manager, Process and Thread Manager , Virtual Memory Manager, I/o Manager, The cache Manager Kernel local procedure calls and IPC, The native API, subsystems.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2013. 2. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2014. 			
Reference Books: <ol style="list-style-type: none"> 1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008 2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006. 3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007 			

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05	16SFC242	Group-2	BIOMETRIC SECURITY
Exam Hours:03		Exam Marks:100	
Module -1 Biometrics: Introduction, benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, selecting a biometric for a system, Applications, Key biometric terms and processes, biometric matching methods, Accuracy in biometric systems.			
Module -2 Physiological Biometric Technologies: Fingerprints: Technical description, characteristics, Competing technologies, strengths, weaknesses, deployment. Facial scan: Technical description, characteristics, weaknesses, deployment. Iris scan: Technical description, characteristics, strengths, weaknesses, deployment. Retina vascular pattern: Technical description, characteristics, strengths, weaknesses, deployment. Hand scan: Technical description, characteristics, strengths, weaknesses, deployment, DNA biometrics.			
Module -3 Behavioral Biometric Technologies: Handprint Biometrics, DNA Biometrics, signature and handwriting technology, Technical description, classification, keyboard / keystroke Dynamics, Voice, data acquisition, feature extraction, characteristics, strengths, weaknesses deployment.			
Module -4 Multi biometrics: Multi biometrics and multi factor biometrics, two-factor authentication with passwords, tickets and tokens, executive decision, implementation plan.			
Module -5 Case studies on Physiological, Behavioral and multifactor biometrics in identification systems.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Samir Nanavathi, Michel Thieme, and Raj Nanavathi, Biometrics –Identity verification in a networked World, Wiley Eastern, 2002. 2. John Chirillo and Scott Blaul, Implementing Biometric Security, Wiley Eastern Publications, 2005.			
Reference Books: 1 John Berger, Biometrics for Network Security, Prentice Hall, 2004.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06	16SCS334	Group-2	CYBER SECURITY AND CYBER LAW
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.			
Module -2 Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops			
Module -3 Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).			
Module -4 Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.			
Module -5 Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of Intellectual - Property – Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives”, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013 2. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI. “Introduction to information security and cyber laws”. Dreamtech Press. ISBN: 9789351194736, 2015			
Reference Books: 1 Thomas J. Mowbray, “Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions”, Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1 2. James Graham, Ryan Olson, Rick Howard, “Cyber Security Essentials”, CRC Press, 15-Dec- 2010			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

07	16SFC12	Group-2	ETHICAL HACKING
Exam Hours:03		Exam Marks:100	
Module -1 Casing the Establishment: What is foot printing, Internet Foot printing, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Case study: Network Security Monitoring.			
Module -2 Securing permission: Securing file and folder permission, Using the encrypting file system, Securing registry permissions. Securing service: Managing service permission, Default services in windows 2000 and windows XP. Unix: The Quest for Root, Remote Access vs Local access, Remote access, Local access, After hacking root.			
Module -3 Dial-up, PBX, Voicemail and VPN hacking, Preparing to dial up, War-Dialing, Brute-Force Scripting PBX hacking, Voice mail hacking, VPN hacking, Network Devices: Discovery Autonomous System Lookup, Public Newsgroups, Service Detection, Network Vulnerability, Detecting Layer 2 Media.			
Module -4 Wireless Hacking: Wireless Foot printing, Wireless Scanning and Enumeration, Gaining Access, Tools that exploiting WEP Weakness, Denial of Services Attacks, Firewalls: Firewalls landscape, Firewall Identification-Scanning Through firewalls, packet Filtering, Application Proxy Vulnerabilities, Denial of Service Attacks, Motivation of Dos Attackers, Types of DoS attacks, Generic Dos Attacks, UNIX and Windows DoS.			
Module -5 Remote Control Insecurities, Discovering Remote Control Software, Connection, Weakness.VNC, Microsoft Terminal Server and Citrix ICA, Advanced Techniques Session Hijacking, Back Doors, Trojans, Cryptography, Subverting the systems Environment, Social Engineering, Web Hacking, Web server hacking web application hacking, Hacking the internet Use, Malicious Mobile code, SSL fraud, E-mail Hacking, IRC hacking, Global countermeasures to Internet User Hacking.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 2010. 2. Bensmith, and Brian Komer, Microsoft Windows Security Resource Kit, Prentice Hall of India, 2010.			
Reference Books: 1 Stuart McClure, Joel Scambray and Goerge Kurtz, “Hacking Exposed Network Security Secrets & Solutions”, 5th Edition, Tata Mc Graw Hill Publishers, 2010. 2. Rafay Baloch, “A Beginners Guide to Ethical Hacking”. 3. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, “Gray Hat Hacking The Ethical Hackers Handbook”, 3rd Edition, McGraw-Hill Osborne Media paperback(January 27, 2011)			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

08	16SFC31	Group-2	FILE SYSTEM FORENSIC ANALYSIS
Exam Hours:03		Exam Marks:100	
Module -1 Volume Analysis: Introduction, Background, Analysis Basics, Summary. PC-based Partitions: DOS Partitions, Analysis Considerations, Apple Partitions, Removable Media. Server-based Partitions: BSD Partitions, Sun Solaris Slices, GPT Partitions, Multiple Disk Volumes: RAID, Disk Spanning.			
Module -2 File System Analysis: What Is a File System?, File System Category, Content Category, Metadata Category, File Name Category, Application Category, Application-level Search Techniques, Specific File Systems FAT Concepts and Analysis: Introduction, File System Category, Content Category, Metadata Category, File Name Category, The Big Picture, Other Topics. FAT Data Structures: Boot Sector, FAT32 FSINFO, FAT, Directory Entries, Long File Name Directory Entries			
Module -3 NTFS Concepts: Introduction, Everything is a File, MFT Concepts, MFT Entry Attribute Concepts, Other Attribute Concepts, Indexes, Analysis Tools. NTFS Analysis: File System Category, Content Category, Metadata Category, File Name Category, Application Category, The Big Picture. NTFS Data Structures: Basic Concepts, Standard File Attributes, Index Attributes and Data Structures, File System Metadata Files.			
Module -4 Ext2 and Ext3 Concepts and Analysis: Introduction, File System Category, Content Category, Metadata Category, File Name Category, Application Category. The Big Picture. Ext2 and Ext3 Data Structures: Superblock, Group Descriptor Tables, Block Bitmap, Inodes, Extended Attributes, Directory Entry, Symbolic Link, Hash Trees, Journal Data Structures			
Module -5 UFS1 and UFS2 Concepts and Analysis: Introduction, File System Category, Content Category, Metadata Category, File Name Category, The Big Picture. UFS1 and UFS2 Data Structures: UFS1 Superblock, UFS2 Superblock, Cylinder Group Summary, UFS1 Group Descriptor, UFS2 Group Descriptor, Block and Fragment Bitmaps, UFS1 Inodes, UFS2 Inodes, UFS2 Extended Attributes, Directory Entries			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Brian Carrier, File System Forensic Analysis, Pearson Education, 2005			
Reference Books: 1 Machtelt Garrels, “Introduction to Linux A Hands-On Guide”, Third Edition, Fultus Corporation Publisher, 2010.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

09	16SSE252	Group-2	INFORMATION RETRIEVAL
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Motivation, Basic concepts, Past, present, and future, The retrieval process. Modeling: Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing.			
Module -2 Retrieval Evaluation: Introduction, Retrieval performance evaluation, Reference collections. Query Languages: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. Query Operations: Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.			
Module -3 Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup languages, Multimedia. Text Operations: Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques.			
Module -4 User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting points, Query specification, Context, Using relevance judgments, Interface support for the search process. Searching the Web: Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Finding the needle in the haystack, Searching using hyperlinks.			
Module -5 Indexing and Searching: Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression. Parallel and Distributed IR: Introduction, Parallel IR, Distributed IR.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Ricardo Baeza-Yates, Berthier Ribeiro-Neto: Modern Information Retrieval, Pearson,1999.			
Reference Books: 1. David A. Grossman, Ophir Frieder: Information Retrieval Algorithms and Heuristics, 2 nd Edition, Springer, 2004			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

10	16SCN21	Group-2	MULTIMEDIA COMMUNICATIONS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,. Text, images, audio and video.			
Module -2 Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG			
Module -3 Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.			
Module -4 Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.			
Module -5 Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Fred Halsall, “Multimedia Communications”, Pearson education, 2001. 2. Raif Steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”, Pearson education, 2002. 			
Reference Books: <ol style="list-style-type: none"> 1 K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Multimedia Communication Systems”, Pearson education, 2004. 2. John Billamil, Louis Molina, “Multimedia : An Introduction”, PHI, 2002. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

11	16SFC13	Group-2	PRAGMATIC OF INFORMATION SECURITY
Exam Hours:03		Exam Marks:100	
Module -1 Overview: Computer Security Concepts, Requirements, Architecture, Trends, Strategy Perimeter Security: Firewalls, Intrusion Detection, Intrusion Prevention systems, Honeypots Case Study: Readings, Intrusion and intrusion detection by John McHugh.			
Module -2 User Authentication: Password, Password-based, token based, Biometric, Remote User authentication. Access Control: Principles, Access Rights, Discretionary Access Control, Unix File Access Control, Role Based Access Control Internet Authentication Applications: Kerberos, X.509, PKI, Federated Identity Management.			
Module -3 Cryptographic Tools: Confidentiality with symmetric encryption, Message Authentication & Hash Functions, Digital Signatures, Random Numbers. Symmetric Encryption and Message Confidentiality: DES, AES, Stream Ciphers, Cipher Block Modes of Operation, Key Distribution.			
Module -4 Internet Security Protocols: SSL, TLS, IPSEC, S/ MIME. Public Key Cryptography and Message Authentication: Secure Hash Functions, HMAC, RSA, Diffie Hellman Algorithms Case Study: Readings, Programming Satan's Computer Ross Anderson and Roger Needham.			
Module -5 Malicious Software: Types of Malware, Viruses & Counter Measures, Worms, Bots, Rootkits Software Security: Buffer Overflows, Stack overflows, Defense, Other overflow attacks Case Study.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Computer Security: Principles and Practice, William Stalling & Lawrie Brown, 2008, Indian Edition 2010, Pearson.			
Reference Books: 1. Readings: Smashing The Stack For Fun And Profit, Aleph One http:// www.phrack.com/ issues.html ? issue = 49&id=14#article 2. Chuck Easttom, “ Computer Security Fundamentals” Pearson, 2012.			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

12	16SFC21	Group-2	PERSERVING AND RECOVERING DIGITAL EVIDENCE
Exam Hours:03		Exam Marks:100	
Module -1 Digital evidence and computer crime: history and terminals of computer crime investigation, technology and law, the investigate process, investigate reconstruction, modus operandi, motive and technology, digital evidence in the court room.			
Module -2 Computer basics for digital investigators: applying forensic science to computers, forensic examination of windows systems, forensic examination of Unix systems, forensic examination of Macintosh systems, and forensic examination of handheld devices.			
Module -3 Networks basics for digital investigators: applying forensic science to networks, digital evidence on physical and datalink layers, digital evidence on network and transport layers, digital evidence on the internet.			
Module -4 Investigating computer intrusions, investigating cyber stalking, digital evidence as alibi.			
Module -5 Handling the digital crime scene, digital evidence examination guidelines.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books 1. Digital Evidence and Computer Crime Forensic science, Computers and Internet -Eoghan Casey, Elsevier Academic Press, Second Edition.			
Reference Books: 1. A Electronic Discovery and Digital Evidence in a Nut Shell-Shira A scheindlin, Daniel J Capra, The Sedona Conference, Academic Press, Third Edition (No where available). 2. Digital Forensic for Network, Internet, and Cloud Computing A forensic evidence guide for moving Targets and Data’ – Terrence V.Lillard, Glint P.Garrison, Craig A..Schiller, James Steele, Syngress.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

13	16SCE334 / 16SIT333 / 16SSE13	Group-2	OBJECT ORIENTED SOFTWARE ENGINEERING
Exam Hours:03		Exam Marks:100	
Module -1 INTRODUCTION: What is software engineering? Software Engineering Concepts, Development Activities, Managing Software Development, Modeling with UML, Project Organization and Communication.			
Module -2 REQUIREMENT ELICITATION AND ANALYSIS: Requirements Elicitation: Requirements Elicitation Concepts, Requirements Elicitation Activities, Managing Requirements Elicitation, Analysis: Analysis Concepts, Analysis Activities, Managing Analysis.			
Module -3 SYSTEM DESIGN :System design-Decomposing the system: Overview of System Design, System Design Concepts, System Design Activities: Objects to Subsystems, System Design –Addressing design goals: Activities: An overview of system design activities, UML deployment diagrams, Addressing Design Goals, Managing System Design.			
Module -4 OBJECT DESIGN, IMPLEMENTATION AND TESTING : Object design-Reusing pattern solutions: An Overview of Object Design, Reuse Concepts: Design Patterns, Reuse Activities, Managing Reuse, Object design-Specifying interface: An overview of interface specification, Interfaces Specification Concepts, Interfaces Specification Activities, Managing Object Design, Mapping model to code: Mapping Models to Code Overview, Mapping Concepts, Mapping Activities, Managing Implementation, Testing: An overview of testing, Testing concepts, Managing testing.			
Module -5 SOFTWARE MAINTENANCE AND SOFTWARE CONFIGURATION MANAGEMENT: Software maintenance: What is Software Maintenance?, Factors that Mandate Change, Lehman’s Laws of system evolution, Types of software maintenance, Software maintenance process and activities, Reverse Engineering, Software Re-engineering, Patterns for Software Maintenance, Tool support for Software Maintenance. Software Configuration Management: The baseline of Software Life Cycle, What is Software Configuration Management, Why Software Configuration Management, Software Configuration Management Functions, Software Configuration Management Tools.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, Pearson Education, 3rd edition, 2014. 2. David C. Kung, “Object oriented software engineering”, Tata McGraw Hill,2015 			
Reference Books: <ol style="list-style-type: none"> 1. Stephan R. Schach, “Object oriented software engineering”, Tata McGraw Hill,2008 2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

01	16SCE153	Group-3	ADVANCES IN COMPUTER ARCHITECTURE
Exam Hours:03		Exam Marks:100	
Module -1 Data-Level Parallelism in vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instructions Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-level Parallelism, Crosscutting Issues, Putting it All Together: Mobile versus Server GPUs and Tesla versus Core i7, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Study and Exercises by Jason D. Bakos.			
Module -2 Thread-Level Parallelism: Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting it All Together: Multicore Processors and Their Performance, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Studies and Exercises by Amr Zaky and David A. Wood.			
Module -3 Thread-Level Parallelism: Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting it All Together: Multicore Processors and Their Performance, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Studies and Exercises by Amr Zaky and David A. Wood.			
Module -4 Vector Processors in More Depth : Why Vector Processors?, Basic Vector Architecture, Two Real-World Issues: Vector Length and Stride, Enhancing Vector Performance, Effectiveness of Compiler Vectorization, Putting it All Together: Performance of Vector Processors, a Modern Vector Supercomputer: The Cray X1 Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Exercises			
Module -5 Hardware and Software for VLIW and EPIC: Introduction: Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor, Concluding Remarks.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Hennessey and Patterson: “Computer Architecture A Quantitative Approach”, 5th Edition, Elsevier, 2013.			
Reference Books: 1. Kai Hwang: Advanced Computer Architecture - Parallelism, Scalability, Programmability, 2nd Edition, Tata McGraw Hill, 2013.			

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As per 2017 Regulation

02	16SCS331	Group-3	APPLICATION AND WEB SECURITY
Exam Hours:03		Exam Marks:100	
Module -1 Web Application (In) security: The Evolution of Web Applications, Common Web Application Functions, Benefits of Web Applications , Web Application Security. Core Defense Mechanisms: Handling User Access Authentication, Session Management, Access Control, Handling User Input, Varieties of Input Approaches to Input Handling, Boundary Validation. Multistep Validation and Canonicalization: Handling Attackers, Handling Errors, Maintaining Audit Logs, Alerting Administrators, Reacting to Attacks.			
Module -2 Web Application Technologies: The HTTP Protocol, HTTP Requests, HTTP Responses, HTTP Methods, URLs, REST, HTTP Headers, Cookies, Status Codes, HTTPS, HTTP Proxies, HTTP Authentication, Web Functionality, Server-Side Functionality, Client-Side Functionality, State and Sessions, Encoding Schemes, URL Encoding, Unicode Encoding, HTML Encoding, Base64 Encoding, Hex Encoding, Remoting and Serialization Frameworks.			
Module -3 Mapping the Application: Enumerating Content and Functionality, Web Spidering, User-Directed Spidering, Discovering Hidden Content, Application Pages Versus Functional Paths, Discovering Hidden Parameters, Analyzing the Application, Identifying Entry Points for User Input, Identifying Server-Side Technologies, Identifying Server-Side Functionality, Mapping the Attack Surface.			
Module -4 Attacking Authentication: Authentication Technologies, Design Flaws in Authentication Mechanisms, Bad Passwords, Brute-Forcible Login, Verbose Failure Messages, Vulnerable Transmission of Credentials, Password Change, Functionality, Forgotten Password Functionality, “Remember Me” Functionality, User Impersonation, Functionality Incomplete, Validation of Credentials, Nonunique Usernames, Predictable Usernames, Predictable Initial Passwords, Insecure Distribution of Credentials. Attacking Access Controls: Common Vulnerabilities, Completely Unprotected, Functionality Identifier-Based Functions, Multistage Functions, Static Files, Platform Misconfiguration, Insecure Access Control Methods.			
Module -5 Attacking Data Stores: Injecting into Interpreted Contexts, Bypassing a Login, Injecting into SQL, Exploiting a Basic Vulnerability Injecting into Different Statement Types, Finding SQL Injection Bugs, Fingerprinting the Database, The UNION Operator, Extracting Useful Data, Extracting Data with UNION, Bypassing Filters, Second-Order SQL Injection, Advanced Exploitation Beyond SQL Injection: Escalating the Database Attack, Using SQL Exploitation Tools, SQL Syntax and Error Reference, Preventing SQL Injection.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. The Web Application Hacker's Handbook: Finding And Exploiting Security 2. Defydd Stuttard, Marcus Pinto Wiley Publishing, Second Edition. 			
Reference Books: <ol style="list-style-type: none"> 1. Professional Pen Testing for Web application, Andres Andreu, Wrox Press. 2. Carlos Serrao, Vicente Aguilera, Fabio Cerullo, “Web Application Security” Springer; 1st Edition 3. Joel Scambray, Vincent Liu, Caleb Sima ,“Hacking exposed”, McGraw-Hill; 3rd Edition, (October, 2010). 4. OReilly Web Security Privacy and Commerce 2nd Edition 2011. 5. Software Security Theory Programming and Practice, Richard sinn, Cengage Learning. 6. Database Security and Auditing, Hassan, Cengage Learning. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

03	16SCS254	Group-3	ADVANCES IN DIGITAL IMAGE PROCESSING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: What is Digital Image Processing, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Spatial and Gray-level Resolution, Zooming and Shrinking Digital Images, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.			
Module -2 Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency-Domain Filters, Sharpening Frequency-Domain Filters, Homomorphic Filtering.			
Module -3 Image Restoration: A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only– Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering ,Minimum Mean Square Error (Wiener) Filtering, Constrained Least Square Filtering, Geometric Mean Filter.			
Module -4 Color Fundamentals: Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images, Color Image Compression. Wavelets and Multiresolution Processing: Image Pyramids, Subband coding, The Haar Transform, Multiresolution Expansions, Wavelet Transforms in one Dimension, Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets. Image Compression: Fundamentals, Image Compression Models, Error-free (Lossless) compression, Lossy Compression			
Module -5 Morphological Image Processing: Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, PHI 2 nd Edition 2005.			
Reference Books: 1. S. Sridhar, Digital Image Processing, Oxford University Press India, 2011. 2. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004. 3. Scott E. Umbaugh: Digital Image Processing and Analysis, CRC Press, 2014. 4. S. Jayaraman, S. Esakkirajan, T. Veerakumar: Digital Image Processing, McGraw Hill Ed. (India) Pvt. Ltd., 2013. 5. Anthony Scime, “Web Mining Applications and Techniques”, Idea Group Publishing,2005.			

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As per 2017 Regulation

04	16SCE31	Group-3	ARM PROCESSORS
Exam Hours:03		Exam Marks:100	
Module -1 An Introduction to Processor Design: Processor architecture and organization. Abstraction in hardware design. A simple processor. Instruction set design. Processor design trade-offs. The Reduced Instruction Set Computer. Design for low power consumption. The ARM Architecture: The Acorn RISC Machine. Architectural inheritance. The ARM programmer's model. ARM development tools			
Module -2 ARM Assembly Language Programming: Data processing instructions. Data transfer instructions. Control flow instructions. Writing simple assembly language programs. ARM Organization and Implementation: 3-stage pipeline ARM organization. 5-stage pipeline ARM organization. ARM instruction execution. ARM implementation. The ARM coprocessor interface			
Module -3 The ARM Instruction Set: Introduction. Exceptions. Conditional execution. Branch and Branch with Link (B, BL) Branch, Branch with Link and exchange instructions (BX, BLX). Software Interrupt (SWI). Data processing instructions. Multiply instructions. Count leading zeros (CLZ - architecture v5T only). Single word and unsigned byte data transfer instructions. Half-word and signed byte data transfer instructions. Multiple register transfer instructions. Swap memory and register instructions (SWP). Status register to general register transfer instructions. General register to status register transfer instructions. Coprocessor instructions. Coprocessor data operations . Coprocessor data transfers. Coprocessor register transfers. Breakpoint instruction (BRK - architecture v5T only). Unused instruction space. Memory faults. ARM architecture variants. Architectural Support for High-Level Languages: Abstraction in software design. Data types. Floating point data types. The ARM floating-point architecture. Expressions. Conditional statements. Loops. Functions and procedures. Use of memory. Run-time environment.			
Module -4 The Thumb Instruction Set: The Thumb bit in the CPSR .The Thumb programmer's model. Thumb branch instructions. Thumb software interrupts instruction. Thumb data processing instructions. Thumb single register data transfer instructions. Thumb multiple register data transfer instructions. Thumb breakpoint instruction. Thumb implementation. Thumb applications. Architectural Support for System Development: The ARM memory interface. The Advanced Microcontroller Bus Architecture (AMBA). The ARM reference peripheral specification. Hardware system prototyping tools. The JTAG boundary scan test architecture. The ARM debug architecture. Embedded Trace. Signal processing support.			
Module -5 ARM Processor Cores: ARM7TDMI. ARM8. ARM9TDMI.ARM10TDMI Memory Hierarchy: Memory size and speed. On-chip memory. Memory management. Architectural Support for Operating Systems. An introduction to operating systems. The ARM system control coprocessor. CP15 protection unit registers. ARM protection unit. CP15 MMU registers. ARM MMU architecture. Synchronization. Context switching. Input / Output.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Steve Furber:<i>ARM System on Chip Architecture</i> by S.B Fuber 2nd Edition, Pearson 2013. 			
Reference Books: <ol style="list-style-type: none"> 1. Steve Furber:<i>ARM System on Chip Architecture</i> by S.B Fuber 2nd Edition, Pearson 2013. 2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012. 3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011. 4. Alan Gates, "Programming Pig", O'Reilley, 2011 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

05	16SCS21	Group-3	MANAGING BIG DATA
Exam Hours:03		Exam Marks:100	
Module -1 UNDERSTANDING BIG DATA: What is big data – why big data –Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.			
Module -2 NOSQL DATA MANAGEMENT: Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schema less databases – materialized views – distribution models – shading — version – map reduce – partitioning and combining – composing map-reduce calculations.			
Module -3 BASICS OF HADOOP: Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.			
Module -4 MAPREDUCE APPLICATIONS: MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats			
Module -5 HADOOP RELATED TOOLS: Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Cassandra – Cassandra data model – Cassandra examples – Cassandra clients –Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012. 2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012. 			
Reference Books: <ol style="list-style-type: none"> 1 Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013. 2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012. 3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011. 4. Alan Gates, "Programming Pig", O'Reilley, 2011 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06	16SCN243	Group-3	ETHERNET TECHNOLOGY
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Introduction to Ethernet, The Evolution of Ethernet, The Ethernet System, The Media Access Control Protocol The media Access Control Protocol Full Duplex Ethernet Auto-Negotiation			
Module -2 Ethernet Media Systems: Ethernet Media Fundamentals Twisted-Pair Media System(10Base-T) Fiber Optic Media System(10Base-F) Fast Ethernet Twisted-Pair Media System(100Base-TX)			
Module -3 Fast Ethernet Fiber Optic Media System(100Base-FX) Gigabit Ethernet Twisted-Pair Media System(1000Base-T) Gigabit Ethernet Fiber Optic Media System (1000Base-X)			
Module -4 Multi-Segment Configuration Guidelines Building Your Ethernet System: structured Cabling Twisted-Pair Cables and Connectors Fiber Optic Cables and Connectors			
Module -5 Ethernet Repeater Hubs Ethernet Switching Hubs Performance and troubleshooting: Ethernet Performance Troubleshooting.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Charles E. Spurgeon: “Ethernet – The Definitive Guide”, O’Reilly 2004.			
Reference Books: 1. Rich Seifert: “Gigabit Ethernet”, Addison-Wesley 1998.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

07	16SCE253	Group-3	DECISION SUPPORT SYSTEM
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to decision support systems: DSS Defined, History of decision support systems, Ingredients of a DSS, Data and model management, DSS Knowledge base, User interfaces, The DSS user, Categories and classes of DSSs, Chapter Summary. Decisions and decision makers Decision makers: who are they, Decision styles, Decision effectiveness, How can a DSS help?, A Typology of decisions, Decision theory and simon’s model of problem solving, Bounded decision making, The process of choice, Cognitive processes, Biases and heuristics in decision making, Chapter summary.			
Module -2 Decisions in the organization: Understanding the organization, Organizational culture. Modeling decision processes: Defining the problem and its structures, Decision models, Types of probability, Techniques for forecasting probabilities, Calibration and sensitivity, Chapter summary			
Module -3 Group decision support and groupware technologies: Group Decision making, the problem with groups, MDM support technologies, Managing MDM activities, the virtual workspace, chapter summary. Executive information systems: What exactly is an EIS, Some EIS history, Why area top executives so different?, EIS components, Making the EIS work, The future of executive decision making and the EIS, chapter summary			
Module -4 Designing and building decision support systems: Strategies for DSS analysis and design, The DSS developer, DSS user interface issues, chapter summary. Implementing and integrating decision support systems: DSS implementation, System evaluation, The importance of integration, chapter summary.			
Module -5 Creative decision making and problem solving What is creativity?, Creativity defined, The occurrence of creativity, Creative problem solving techniques, Creativity and the role of technology, chapter summary.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 George M.Marakas: DECISION SUPPORT SYSTEM, PHI.2011.			
Reference Books: 1 NIL			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

08	16SCE154/16SIT154/16SSE152	Group-3	DISTRIBUTED OPERATING SYSTEM
Exam Hours:03		Exam Marks:100	
Module -1			
<p>Fundamentals: What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed Computing Environment (DCE). Message Passing: Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.</p>			
Module -2			
<p>Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC.</p>			
Module -3			
<p>Distributed Shared Memory: Introduction, General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms.</p>			
Module -4			
<p>Resource Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach Process Management: Introduction, Process Migration, Threads.</p>			
Module -5			
<p>Distributed File Systems: Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles.</p>			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.			
Reference Books:			
1 Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

09	16SFC323	Group-3	MOBILE DEVICE FORENSICS
Exam Hours:03		Exam Marks:100	
Module -1 Android and mobile forensics: Introduction, Android platform, Linux, Open source software and forensics, Android Open Source Project, Internationalization, Android Market, Android forensics			
Module -2 Android hardware platforms: Overview of core components, Overview of different device types, Read-only memory and boot loaders, Manufacturers, Specific devices			
Module -3 Android software development kit and android debug bridge: Android platforms, Software development kit (SDK), Android security model, Forensics and the SDK.			
Module -4 Android file systems and data structures: Data in the shell, Type of memory, File systems, Mounted file systems and directory structures. Android forensic techniques: Procedures for handling an Android device, Imaging Android USB mass storage devices, Logical techniques, Physical techniques			
Module -5 Android device data and app security: Data theft targets and attack vectors, Security considerations, Individual security strategies, Corporate security strategies, App development security strategies. Android application and forensic analysis: Analysis techniques, FAT forensic analysis, YAFFS2 forensic analysis, Android app analysis			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Android Forensics Investigation, Analysis, and Mobile security for Google Android, Andrew Hoog, John McCash, Technical Editor, Elsevier, 2011.			
Reference Books: 1. Satish Bommisetty, Rohit Tamma, Heather Mahalik “Practical Mobile Forensics”, Kindle Edition, Packt Publishing (21 July 2014). 2. Andrew Martin,” Mobile Device Forensics”, © SANS Institute 2009			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

10	16LNI13	Group-3	NETWORK PROGRAMMING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to network application, client/server communication, OSI Model, BSD Networking history, Test Networks and Hosts, Unix Standards, 64-bit architectures, Transport Layer: TCP, UDP and SCTP.			
Module -2 Sockets Introduction – socket address structures, value-result arguments, byte ordering and manipulation functions, address conversion functions, Elementary TCP Sockets – socket, connect, bind, listen, accept , fork and concurrent server design, getsockname and getpeername functions and TCP Client/Server Example-client/server programming through TCP sockets, Normal startup, termination, POSIX signal handling, Signal handling in server, Crashing, rebooting of server host, shutdown			
Module -3 I/O Multiplexing and Socket Options, Elementary SCTP Sockets- Interface Models, sctp_xx functions, shutdown function, Notifications, SCTP Client/Server Examples – One-to-Many, Head-of-Line Blocking, Controlling number of streams and Termination, IPv4 and IPv6 Interoperability–different interoperability scenarios.			
Module -4 Daemon Processes, syslogd, daemonizing functions and the inetd super server, Advanced I/O functions- readv, writev, sendmsg and recvmsg, Ancillary data, Advanced polling, Unix domain protocols- socket address structure, functions and communication scenarios, Nonblocking I/O – connect and accept examples.			
Module -5 ioctl operations- socket, file, interface configuration information, ARP cache and routing table operations, Routing sockets- data link socket address structure, reading and writing, sysctl operations, interface name and index functions, Key Management functions – reading, writing, SADB, SA, Dynamically Maintaining SA's, Out-of-Band data, Threads- basic thread functions, TCP echo server using threads, Mutexes and Conditional variables.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: “UNIX Network Programming”. Volume 1, Third Edition, Pearson 2004.			
Reference Books: 1 Barry Nance: “Network Programming in C”, PHI 2002 3.Bob Quinn, Dave Shute: “Windows Socket Network Programming”, Pearson 2003. 2. Richard Stevens: “UNIX Network Programming”. Volume 2, Second Edition.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

11	16LNI21	Group-3	NETWORK PROTOCOL DESIGN
Exam Hours:03		Exam Marks:100	
Module -1 How to specify network protocols? Semantics of traditional protocol specifications, syntax of traditional protocol. Network processes constants, inputs, and variables. Specifications in new protocol, A vending machine protocol, a request/reply protocol, a Manchester encoding protocol. Current internet			
Module -2 Protocol execution processes in the internet. Nondeterministic assignment process arrays, protocol process communication in the internet, Types of transmission errors. Error occurrence. Normal timeout actions implementing transmission errors in the internet connections: using timeouts connections, using identifiers full-duplex and half-duplex connections. Connections in the internet.			
Module -3 Detection of message corruption. Detection of message loss, detection of message reorder, error detection in the internet. Error recovery-forward & backward error recovery. Cumulative acknowledgment, individual acknowledgment, blocks acknowledgment error recovery in the internet flow control. Window size control, rate control, circular buffer control, flow control in the internet.			
Module -4 Local and global topology information, maintaining local topology information, hierarchical topology information topology information in the internet, Abstraction of perfect channel in the internet, Hierarchical routing, random routing.			
Module -5 Asymmetric and symmetric keys authentication. Privacy and integrity non-repudiation authorization. Message digest security in the internet data compression. Huffman coding, static Huffman compression, dynamic Huffman compression. Context sensitive compression, lossy compression, data compression in the internet.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Mohamed G. Gouda, “ Elements of Network Protocol Design ”, John Wiley & Sons 2004.			
Reference Books: 1. Douglas E Comer, “ Computer Networks and Internet with Internet Applications ”, Fourth Edition, Pearson 2004			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

12	16LNI11	Group-3	SEMANTIC WEB AND SOCIAL NETWORKS
Exam Hours:03		Exam Marks:100	
Module -1 Web Intelligence Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today’s Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.			
Module -2 Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.			
Module -3 Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.			
Module -4 Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.			
Module -5 Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books 1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.			
Reference Books: 1. Semantic Web Technologies, Trends and Research in Ontology Based Systems. 2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group). 3. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor, O’Reilly.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

13	16SIT321	Group-3	SUPLY CHAIN MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction to Supply Chain Management : Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – obstacles – framework – facilities – inventory – transportation – information – sourcing – pricing.			
Module -2			
Designing the supply chain network : Designing the distribution network – role of distribution – factors influencing distribution – design options – e-business and its impact – distribution networks in practice – network design in the supply chain – role of network – factors affecting the network design decisions – modeling for supply chain.			
Module -3			
Designing and Planning Transportation Networks.: Role of transportation - modes and their performance - transportation infrastructure and policies - design options and their trade-offs - Tailored transportation.			
Module -4			
Sourcing and Pricing: Sourcing – In-house or Outsource – 3rd and 4th PLs – supplier scoring and assessment, selection – design collaboration – procurement process – sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts.			
Module -5			
Information Technology in the supply chain: IT Framework – customer relationship management – internal supply chain management – supplier relationship management – transaction management – future of IT.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Sunil Chopra and Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson/PHI, 3rd Edition, 2007.			
2. Coyle, Bardi, Longley, The management of Business Logistics – A supply Chain Perspective, Thomson Press, 2006.			
3. Supply Chain Management by Janat Shah Pearson Publication 2008.			
Reference Books:			
1 Donald J Bowersox, Dand J Closs, M Bixby Coluper, Supply Chain Logistics Management, TMH, Second Edition, 2008.			
2. Wisner, Keong Leong and Keah-Choon Tan, Principles of Supply Chain Management A Balanced pproach, Thomson Press, 2005.			
3. David Simchi-Levi et al, Designing and Managing the Supply Chain – Concepts, ISBN-13: 978-0072357561			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

01	16SCS251	Group-4	ADVANCES IN COMPUTER GRAPHICS
Exam Hours:03		Exam Marks:100	
Module -1 Three-Dimensional Object Representations: Polyhedra, OpenGL Polyhedron Functions, Curved Surfaces, Quadric Surfaces, Super quadrics, OpenGL Quadric-Surface and Cubic-Surface Functions, Blobby Objects, Spline Representations, Cubic-Spline Interpolation Methods, Bezier Spline Curves, Bazier Surfaces B-Spline Curves, B-Spline Surfaces, Beta- Splines, Retional Splines, Conversion Between Spline Representations, Displaying Spline Curves and rfaces, OpenGL Approximation-Spline Functions, Sweep Representations, Constructive Solid –Geometry Method, Octrees, BSP T rees, Fractal-Geometry Methods, Shape Grammars and Others Procedural Methods, Particle Systems, Physically Based Modeling, Visualization Of Data Sets.			
Module -2 Visible-Surface Detection Methods: Classification Of Visible –Surface Detection Algorithms, Back-Face Method, Depth-Buffer Method, A-Buffer Method, Scan-Line Method, BSP-Tree Method, Area-Subdivision Method, Octree Methods, Ray-Casting Method, Comparison of Visibility –Detection Methods, Curved Surfaces, Wire-Frame Visibility –De tectio n Functions			
Module -3 Illumination Models and Surface- Rendering Methods: Light Sources, Surface Lighting Effects, Basic Illumination Models, Transparent Surfaces, Atmospheric Effects, Shadows, Camera parameters, Displaying light intensities, Halftone patterns anddithering techniques, polygon rendering methods, ray-tracing methods, Radiosity lighting model, Environment mapping, Photon mapping, Adding surface details, Modeling surface details with polygons, Texture mapping, Bump mapping, OpenGL Illumination and surface-rendering functions, openGL texture functions.			
Module -4 Color models, color applications and Computer animation: Properties of light, Color models, Standard primaries and the chromaticity diagram, The RGB color model, The YIQ and related color models, The CMY and CMYK color models, The HSV color model, The HLS color model, Color Selection and applications. Raster methods for computer animation, Design of animations sequences, Traditional animation techniques, General computer-animation functions, Computer-animation languages, Key-frame systems, Motion specification, Articulated figure animation, Periodic motions, OpenGL animation procedu res.			
Module -5 Hierarchical modeling and Graphics file formats: Basic modeling concepts, Modeling packages, General hierarchical modeling methods, Hierarchical modeling using openGL display list, Image-File configurations, Color-reduction methods, File-compression techniques, Composition of the major file formats.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Computer Graphics with openGL-Hearn Baker 4rd edition, Pearson publication.2010. 2. James D Foley,Andries van dam,Steven K Feiner,John F Hughes, Computer graphics, Pearson Education 3rd edition, 2013. 			
Reference Books: <ol style="list-style-type: none"> 1. Edward Angel: Interactive Computer graphics a top-down approach with openGL, Addison Wesley, 6th edition 2012. 2. Advanced graphics programming using openGL: Tom Mc Reynolds-David Blythe. Elesvier.MK, 2005. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

02	16SCS13	Group-4	ADVANCES IN DATABASE MANAGEMENT SYSTEM
Exam Hours:03		Exam Marks:100	
Module -1			
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Overview of Object-Oriented Concepts – Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism, examples.			
Module -2			
Object and Object-Relational Databases: Overview of OOP; Complex objects; Identity, structure etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; syntax and demo examples, The nested relational model. Overview of C++ language binding;			
Module -3			
Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.			
Module -4			
Data Warehousing, Decision Support and Data Mining: Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support, View materialization, Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; ROC and CMC Curves; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks.			
Module -5			
Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
<ol style="list-style-type: none"> 1. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education, 2013. 2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2013. 			
Reference Books:			
<ol style="list-style-type: none"> 1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGraw Hill, 2010. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

03	16SSE12	Group-4	ADVANCES IN SOFTWARE TESTING
Exam Hours:03		Exam Marks:100	
<p>Module -1 Basics of Software Testing and Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudocode, The triangle problem, The NextDate function, The commission problem, The SATM (Simple Automatic Teller Machine) problem.</p>			
<p>Module -2 Decision Table-Based Testing: Decision tables, Test cases for the triangle problem, Test cases for the NextDate function, Test cases for the commission problem, Guidelines and observations. Data Flow Testing: Definition-Use testing, Slice-based testing, Guidelines and observations. Levels of Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing. Integration Testing: A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integrations, Case study.</p>			
<p>Module -3 System Testing: Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines, ASF (Atomic System Functions) testing example. Interaction Testing: Context of interaction, A taxonomy of interactions, Interaction, composition, and determinism, Client/Server Testing,. Issues in Object-Oriented Testing: Units for object-oriented testing, Implications of composition and encapsulation, inheritance, and polymorphism, Levels of object-oriented testing, GUI testing, Dataflow testing for object-oriented software, Examples. Class Testing: Methods as units, Classes as units.</p>			
<p>Module -4 Object-Oriented Integration Testing: UML support for integration testing, MM-paths for object-oriented software, A framework for object-oriented dataflow integration testing. GUI Testing: The currency conversion program, Unit testing, Integration Testing and System testing for the currency conversion program. Object-Oriented System Testing: Currency converter UML description, UML-based system testing, Statechart-based system testing.</p>			
<p>Module -5 Exploratory Testing: The context-driven school, Exploring exploratory testing, Exploring a familiar example, Exploratory and context-driven testing observations. Model-Based Testing: Testing based on models, Appropriate models, Use case-based testing, Commercial tool support for model-based testing. Test-Driven Development: Test-then-code cycles, Automated test execution, Java and JUnit example, Remaining questions, Pros, cons, and open questions of TDD, Retrospective on MDD versus TDD.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books: 1. Paul C. Jorgensen: Software Testing, A Craftsman’s Approach, 3rd Edition, Auerbach Publications, 2013.</p>			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. 1. Aditya P Mathur: Foundations of Software Testing, Pearson, 2008. 2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

04	16SCS23	Group-4	CLOUD COMPUTING
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.			
Module -2			
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.			
Module -3			
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems			
Module -4			
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.			
Module -5			
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013.			
Reference Books:			
1. Rajkumar Buyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014. 2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

05	16SCE13/16SCS152	Group-4	EMBEDDED COMPUTING SYSTEMS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.			
Module -2 Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systems-network protocols, Wireless and mobile system protocols.			
Module -3 Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.			
Module -4 Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Inter-process communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.			
Module -5 Real-time operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Raj Kamal, “Embedded Systems: Architecture, Programming, and Design” 2nd edition , Tata McGraw hill-2013.			
Reference Books: 1. Marilyn Wolf, “Computer as Components, Principles of Embedded Computing System Design” 3rd edition, Elsevier-2014.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06	16SFC13	Group-4	CYBER CRIME AND CYBER FORENSICS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime, Social Engineering, Categories of Cyber Crime, Property Cyber Crime.			
Module -2 Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation ,Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.			
Module -3 Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.			
Module -4 Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies, Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.			
Module -5 Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Bernadette H Schell, Clemens Martin, “Cybercrime”, ABC – CLIO Inc, California, 2004. ”Understanding Forensics in IT “, NIIT Ltd, 2005. 2. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009. 			
Reference Books: <ol style="list-style-type: none"> 1. Kevin Mandia, Chris Prosis, Matt Pepe, “Incident Response and Computer Forensics “, Tata McGraw - Hill, New Delhi, 2006. 2. Robert M Slade,” Software Forensics”, Tata McGraw - Hill, New Delhi, 2005. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

07	16SFC241	Group-4	CYBER LAWS AND ETHICS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Cyber Law and Cyber Ethics: Introduction to Cyber Crimes and Ethical Issues in IT, Basic concepts of Law and Information Security, overview of Information Security obligations under ITA 2008, Privacy and data protection concepts.			
Module -2 Law of Contracts applicable for Cyber Space transactions: introduction to Contract law, legal recognition of Electronic Documents, Authentication of Electronic Documents, Authentication of Electronic Documents, Cyber space contracts, Resolution of Contractual disputes, stamping of Contractual document.			
Module -3 Intellectual Property Law for Cyber Space: Concept of Virtual assests, nature of Intellectual property, Trademarks and domain names, copyright law, law of patents.			
Module -4 Intellectual Property Law for Cyber Space: Concept of Virtual assests, nature of Intellectual property, Trademarks and domain names, copyright law, law of patents.			
Module -5 Miscellaneous Issues in Cyber Crimes and Cyber Security: Cyber Crime Investigation and Prosecution, Digital evidence and Cyber forensics, Jurisdiction issues, Information Security Management in corporate Sector.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 Cyber Laws for Engineers, Naavi, Ujvala Consultants Pvt Ltd, 2010.			
Reference Books: 1 Deborah G Johnson, Computer Ethics, Pearson Education Pub., ISBN : 81-7758-593-2. 2. Earnest A. Kallman, J.P Grillo, Ethical Decision making and Information Technology: An Introduction with Cases, McGraw Hill Pub. 3. John W. Rittinghouse, William M. Hancock, Cyber security Operations Handbook, Elsevier Pub. 4. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, 2nd Edition, Cengage Learning Pub. 5. Randy Weaver, Dawn Weaver, Network Infrastructure Security, Cengage Learning Pub			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

08	16SCN323	Group-4	INFORMATION SECURITY POLICES IN INDUSTRY
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Information Security Policies: About Policies, why Policies are Important, When policies should be developed, How Policy should be developed, Policy needs, Identify what and from whom it is being protected, Data security consideration, Backups, Archival storage and disposal of data, Intellectual Property rights and Policies, Incident Response and Forensics, Management Responsibilities, Role of Information Security Department, Security Management and Law Enforcement, Security awareness training and support.			
Module -2 Policy Definitions, Standards, Guidelines, Procedures with examples, Policy Key elements, Policy format and Basic Policy Components, Policy content considerations, Program Policy Examples, Business Goal Vs Security Goals, Computer Security Objectives, Mission statement Format, Examples, Key roles in Organization, Business Objectives, Standards: International Standards.			
Module -3 Writing The Security Policies: Computer location and Facility construction, Contingency Planning, Periodic System and Network Configuration Audits, Authentication and Network Security, Addressing and Architecture, Access Control, Login Security, Passwords, User Interface, Telecommuting and Remote Access, Internet Security Policies, Administrative and User Responsibilities, WWW Policies, Application Responsibilities, E-mail Security Policies.			
Module -4 Establishing Type of Viruses Protection: Rules for handling Third Party Software, User Involvement with Viruses, Legal Issues, Managing Encryption and Encrypted data, Key Generation considerations and Management, Software Development policies, Processes Testing and Documentation, Revision control and Configuration management, Third Party Development, Intellectual Property Issues.			
Module -5 Maintaining the Policies: Writing the AUP, User Login Responsibilities, Organization's responsibilities and Disclosures, Compliance and Enforcement, Testing and Effectiveness of Policies, Publishing and Notification Requirements of the Policies, Monitoring, Controls and Remedies, Administrator Responsibility, Login Considerations, Reporting of security Problems, Policy Review Process, The Review Committee, Sample Corporate Policies, Sample Security Policies.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Scott Barman, Writing Information Security Policies, Sams Publishing, 2002. 2. Thomas.R.Peltier, Information Policies, Procedures and Standards, CRC Press, 2004. 			
Reference Books: <ol style="list-style-type: none"> 1 Thomas R Peltier, Justin Peltier, John Backley, “ Information Security Fundamentals”, Auerbach publications, CRC Press, 2005. 2. Harold F. Tipton and Micki Krause “Information Security Management Handbook”, Auerbach publications, 5th Edition, 2005. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

09	16SCN253	Group-4	NETWORK MANAGEMENT
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction: Analogy of Telephone Network Management, Data and Telecommunication Network Distributed computing Environments, TCP/IP-Based Networks: The Internet and Intranets, Communications Protocols and Standards- Communication Architectures, Protocol Layers and Services; Case Histories of Networking and Management – The Importance of topology , Filtering Does Not Reduce Load on Node, Some Common Network Problems; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions- Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management System platform, Current Status and Future of Network Management.</p>			
<p>Module -2 Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1- Terminology, Symbols, and Conventions, Objects and Data Types, Object Names, An Example of ASN.1 from ISO 8824; Encoding Structure; Macros, Functional Model.</p>			
<p>Module -3 SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base. The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group, Functional Model SNMP Management – RMON: Remote Monitoring, RMON SMI and MIB, RMON1- RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups, RMON2 – The RMON2 Management Information Base, RMON2 Conformance Specifications.</p>			
<p>Module -4 Broadband Network Management: Broadband Access Networks and Technologies: Broadband Access Networks, Broadband Access Technology; HFCT Technology: The Broadband LAN, The Cable Modem, The Cable Modem Termination System, The HFC Plant, The RF Spectrum for Cable Modem; Data Over Cable, Reference Architecture; HFC Management – Cable Modem and CMTS Management, HFC Link Management, RF Spectrum Management, DSL Technology; Asymmetric Digital Subscriber Line Technology – Role of the ADSL Access Network in an Overall Network, ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management – ADSL Network Management Elements, ADSL Configuration Management, ADSL Fault Management, ADSL Performance Management, SNMP Based ADSL Line MIB, MIB Integration with Interfaces Groups in MIB-2, ADSL Configuration Profiles</p>			
<p>Module -5 Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation 24 Techniques, Performance Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Event Correlation Techniques – Rule-Based Reasoning, Model-Based Reasoning, Case Based Reasoning, Codebook correlation Model, State Transition Graph Model, Finite State Machine Model, Security Management – Policies and Procedures, Security Breaches and the Resources Needed to Prevent Them, Firewalls, Cryptography, Authentication and Authorization, Client/Server Authentication Systems, Messages Transfer Security, Protection of Networks from Virus Attacks, Accounting Management, Report Management, Policy- Based Management, Service Level Management.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books: 1. Mani Subramanian: Network Management- Principles and Practice, 2nd Pearson Education, 2010.</p>			
<p>Reference Books: 1. J. Richard Burke: Network management Concepts and Practices: a Hands-On Approach, PHI, 2008.</p>			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

10	16SCS333	Group-4	NATURAL LANGUAGE PROCESSING AND TEXT MINING
Exam Hours:03		Exam Marks:100	
Module -1 OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications- Information Retrieval. Language Modeling: Various Grammar-based Language Models- Statistical Language Model.			
Module -2 WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.			
Module -3 Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.			
Module -4 Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Matrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically-Based Text Mining: Related Work, A Semantically Guided Model for Effective TextMining.			
Module -5 INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008. 2. Anne Kao and Stephen R. Poteet (Eds), “Natural LanguageProcessing andText Mining”,Springer-Verlag London Limited 2007. 			
Reference Books: <ol style="list-style-type: none"> 1 Daniel Jurafsky and James H Martin, “Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition”, 2nd Edition, Prentice Hall, 2008. 2. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummingspublishing company, 1995. 3. Gerald J. Kowalski and Mark.T. Maybury, “Information Storage and Retrieval systems”, Kluwer academic Publishers, 2000. 4. Steven Bird, Ewan Klein, Edward Loper, “Natural Language Processing with Python,” Publisher: O’Reilly Media, June 2009 5. Christopher D.Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

11	16SCN244	Group-4	MOBILE APPLICATION DEVELOPMENT
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.			
Module -2 Fundamentals of Android Development: Introduction to Android., The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator.			
Module -3 The Intent of Android Development, Four kinds of Android Components: Activity, Service, Broadcast Receiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API.			
Module -4 Creating the Activity, Working with views: Exploring common views, using a list view, creating custom views, understanding layout. Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments. Multimedia: Playing Audio, Playing Video and Capturing Media. Advanced Android Programming: Internet, Entertainment, and Services.			
Module -5 Displaying web pages and maps, communicating with SMS and emails. Creating and using content providers: Creating and consuming services, publishing android applications			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Mobile Computing: (technologies and Applications-N. N. Jani S chand 2. B.M.Hirwani- Android programming Pearson publications-2013 3. W. Frank Ableson, Robi Sen and C. E. Ortiz - Android in Action, Third Edition-2012 DreamTech Publisher 			
Reference Books: <ol style="list-style-type: none"> 1. NILL 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

12	16SFC321	Group-4	SECURITY ARCHITECTURE DESIGN
Exam Hours:03		Exam Marks:100	
Module -1 Architecture and Security: Architecture Reviews, Software Process, Reviews and the Software Development Cycle, Software Process and Architecture Models, Software Process and Security, Architecture Review of System, Security Assessments, Security Architecture Basics, Architecture Patterns in Security			
Module -2 Low-Level Architecture: Code Review, importance of code review, Buffer Overflow Exploits, Countermeasures Against Buffer Overflow Attacks, patterns applicable, Security and Perl, Bytecode Verification in Java-Good Coding Practices Lead to Secure Code, Cryptography, Trusted Code, Secure Communications.			
Module -3 Mid-Level Architecture: Middleware Security, Middleware and Security, The Assumption of Infallibility, The Common Object Request Broker Architecture, The OMG CORBA Security Standard, Vendor Implementations of CORBA Security, CORBA Security Levels, Secure Interoperability, Application, Unaware Security, Application, Aware Security, Application Implications, Web Security, Application and OS Security, Database Security.			
Module -4 High-Level Architecture: Security Components, Secure Single Sign-On- Public-Key Infrastructures, Firewalls, Intrusion Detection Systems, LDAP and X.500 Directories, Kerberos, Distributed Computing Environment, The Secure Shell, or SSH, The Distributed Sandbox, Security and Other Architectural Goals, Metrics for Non- Functional Goals, Force Diagrams around Security, High Availability, Robustness, Reconstruction of Events, Ease of Use, Maintainability, Adaptability, and Evolution, Scalability, Interoperability, Performance, Portability.			
Module -5 Enterprise Security Architecture: Security as a Process, Security Data, Enterprise Security as a Data Management Problem, Tools for Data Management, David Isenberg and the “Stupid Network”, Extensible Markup Language, The XML Security Services Signaling Layer, XML and Security Standards, The Security Pattern Catalog Revisited, XML-Enabled Security Data-HGP: A Case Study in Data Management, Business Cases and Security, Building Business Cases for Security Case study: Building secure OS for Linux: Linux security modules, security enhanced Linux.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books 1. Jay Ramachandran, Designing Security Architecture Solutions, Wiley Computer Publishing, 2010.			
Reference Books: 1. Markus Schumacher, Security Patterns: Integrating Security and Systems Engineering, Wiley Software Pattern Series, 2010.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

13	16LNI252	Group-4	SOFTWARE AGENTS
Exam Hours:03		Exam Marks:100	
<p>Module -1 An introduction to Software Agents Why Software Agents? Simplifying Computing, Barriers to Intelligent Interoperability, Incorporating Agents as Resource Managers, Overcoming user Interface Problems, Toward Agent-Enabled System Architectures. Agents: From Direct Manipulation to Delegation Introduction, Intelligent Interfaces, Digital Butlers, Personal Filters, Digital sisters-in-Law, Artificial Intelligence, Decentralization, Why Linking works, The Theatrical Metaphor, Conclusion: Direct Manipulation and Digital Butlers, Acknowledgements. Interfaces Agents Metaphors with Character Introduction, Objections to Agents, In Defense of Anthropomorphism, Key Characteristics of Interface Agents, Agency, Responsiveness, Competence, Accessibility, Design and Dramatic Character, An R & D Agenda.</p>			
<p>Module -2 Designing Agents as if People Mattered: What does “Agents” Mean?, Adaptive Functionality: Three Design Issues, The Agent Metaphor: Reactions and Expectations The Agent Conceptual Model. Direct Manipulation versus Agents: Paths to Predict able, Controllable, and Comprehensible Interfaces: Introduction, General Concerns About Intelligent Interfaces, Learning From History, What Is an Agent?, Looking at the Components, Realizing a New Vision, Tree Maps, Dynamic Queries, Back to a Scientific Approach, Acknowledgements. Agents for Information Sharing and Coordination: A History and some Reflections: Information, Lens: An Intelligent Tool for Managing Electronic Messages, Semiformal Systems an d Radical Tailorability, Oval: A Radically Tailorable Tool for Information Management and Cooperative Work, Examples of Application and Agents in Oval, Conclusions: An Addendum: The Relationship between Oval and Objects Lens .</p>			
<p>Module -3 Agents that Reduce Work and Information Overload Introduction, Approaches to Building Agents, Training a Personal Digital Assistant, Some Example of Existing Agents, Electronic Mail Agents, Meeting Scheduling Agent, News Filtering Agent, Entertainment Selection Agent, Discussion, Acknowledgements Software Agents for Cooperative Learning: Computer-Supported Cooperative Learning, Examples of Software Agents for Cooperative Learning, Examples of Software Agents for Cooperative Learning, Developing an Example, Discussion and Perspectives.</p>			
<p>Module -4 An Overview of Agent-Oriented Programming: Agent-Oriented Programming: Software with Mental State, Two SCENarios, On the Mental state of agents, Generic Agent Interpreter, AGENT-0: A Simple Language and its Interpreter, KQML as an Agent Communication Language: The approach of knowledge sharing effort(KSE), The Solution of the knowledge sharing efforts, knowledge Query Manipulation Language (KQML),Implementation, Application of KQML , Other Communication Language, The Approach of Knowledge-Sharing Effect,(KSE),The Solutions of the Sharing Effect.</p>			
<p>Module -5 Agent for Information Gathering: Agent Organization, The Knowledge of an Agent, The Domain Model of an Agent, Modeling other Agent, communication language and protocol, query processing, an information goal, information source selection, generating a query access plan, interleaving planning and execution , semantic query optimization, learning, caching retrieved data, related work, discursion, acknowledgement. Mobile Agents: Enabling Mobile Agents, Programming Mobile Agents, Using Mobile Agents.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books: 1. Jeffrey M. Bradshaw: Software Agents, PHI (MIT Press) 2012.</p>			
<p>Reference Books: 1 Lin Padgham and Michael Winikoff, “Developing Intelligent Agent Systems: A Practical Guide”, John Wiley & sons Publication, 2004. 2. Steven F. RailsBack and Volker Grimm, “Agent-Based and Individual Based modeling: A Practical Introduction”, Princeton University Press, 2012. 3. Peter Wayner, “Disappearing Cryptography – Information Hiding: Steganography & Watermarking”, Morgan Kaufmann Publishers, New York, 2002. 4. Frank Y. Shih, “Multimedia Security, Watermarking, Steganography and Forensics”, CRC Press</p>			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

14	16SCE333	Group-4	SOFTWARE DEFINED NETWORK
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction. Centralized and Distributed Control and Data Planes. Introduction -Evolution versus Revolution. What Do They Do? - The Control Plane, Data Plane, Moving Information Between Planes, Why Can Separation Be Important? Distributed Control Planes - IP and MPLS, Creating the IP Underlay, Convergence Time, Load Balancing, High Availability, Creating the MPLS Overlay, Replication. Centralized Control Planes - Logical Versus</p>			
<p>Module -2 OpenFlow. Introduction - Wire Protocol, Replication, FAWG (Forwarding Abstraction Workgroup), Config and Extensibility, Architecture. Hybrid Approaches - Ships in the Night, Dual Function Switches. SDN Controllers. Introduction. General Concepts – Vmware, Nicira, Vmware/Nicira, OpenFlow-Related, Mininet, NOX/POX. Trema, Ryu, Big Switch Networks/Floodlight. Layer 3 Centric - L3VPN, Path Computation Element Server. OF-CONFIG.</p>			
<p>Module -3 Network Programmability. Introduction. The Management Interface. The Application-Network Divide - The Command-Line Interface, NETCONF and NETMOD, SNMP. Modern Programmatic Interfaces - Publish and Subscribe Interfaces, XMPP. Google’s Protocol Buffers - Thrift. JSON, I2RS. Modern Orchestration - OpenStack. CloudStack, Puppet.</p>			
<p>Module -4 Network Function Virtualization. Introduction. Virtualization and Data Plane I/O - Data Plane I/O, I/O Summary. Services Engineered Path. Service Locations and Chaining – Metadata, An Application Level Approach, Scale, NFV at ETSI. Non-ETSI NFV Work - Middlebox Studies, Embrane/LineRate, Platform Virtualization. Add OVS, OVN, OPNFV, Openstack</p>			
<p>Module -5 Building an SDN Framework. Introduction. Build Code First; Ask Questions Later. The Juniper SDN Framework. IETF SDN Framework(s) – SDN (P), ABNO. Open Daylight Controller/Framework – API, High Availability and State Storage, Analytics. Policy, MD-SAL, VTN, OVSDB. ONOS Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring. Introduction. Bandwidth Calendaring - Base Topology and Fundamental Concepts, OpenFlow and PCE Topologies, Example Configuration, OpenFlow Provisioned Example, Enhancing the Controller. Overlay Example Using PCE Provisioning, Expanding your reach: Barbarians at the gate. Big Data and Application Hyper-virtualization for Instant CSPF expanding topology.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844 2. Software defined networks: Design and Deployment, Patricia A. Morreale and James M. Anderson. CRC Press, December 2014, ISBN: 9781482238631 3. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014. 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Paul Goransson, Chuck Black: Software Defined Networks A Comprehensive Approach , Elsevier, 2014. Paperback ISBN: 9780128045558, eBook ISBN: 9780128045794 2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2. 3. When SDN Meets Hadoop big data analysis, things get dynamic – Conrad Menezes – TechTarget. 4. Programming your network at run-time for big data applications – Guohui Wang et..al –ACM SIGCOMM HotSDN 2012. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

01	16SCS22	Group-5	ADVANCED ALGORITHMS
Exam Hours:03		Exam Marks:100	
Module -1			
Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.			
Module -2			
Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.			
Module -3			
Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization			
Module -4			
String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.			
Module -5			
Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3 rd Edition, Prentice-Hall of India, 2010.			
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.			
Reference Books:			
1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2 nd Edition, Universities press, 2007			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

02	16SCS151	Group-5	ADVANCES IN COMPUTER NETWORKS
Exam Hours:03		Exam Marks:100	
Module -1 Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels. T1: Chapter 1.1, 1.2, 1.5.1, 1.5.2., 2.1, 2.5 T2: Chapter 4			
Module -2 Internetworking I: Switching and Bridging, Datagram’s, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. T1: Chapter 3.1, 3.2,			
Module -3 Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP T1: Chapter 3.3, 4.1.1,4.1.3 T2:Chapter 13.1 to 13.18 , Ch 18.			
Module -4 End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End to- End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery T1: Chapter 5.1, 5.2.1 to 5.2.8, 6.2, 6.3			
Module -5 Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web (HTTP), Network Management (SNMP) T1: Chapter 6.4 T2: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Larry Peterson and Bruce S Davis “Computer Networks :A System Approach” 5 th Edition , Elsevier -2014. 2. Douglas E Comer, “Internetworking with TCP/IP, Principles, Protocols and Architecture” 6 th Edition, PHI – 2014.			
Reference Books: 1. Uyles Black, “Computer Networks, Protocols , Standards and Inte rfaces” 2 nd Edition -PHI. 2. Behrouz A Forouzan, “TCP /IP Protocol Suite” 4 th Edition – Tata McGraw-Hill.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

03	16SCS243	Group-5	BUSINESS INTELLIGENCE AND ITS APPLICATIONS
Exam Hours:03		Exam Marks:100	
Module -1 Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Drivers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved In These Activities, Risks Of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation			
Module -2 Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process			
Module -3 Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery			
Module -4 Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard			
Module -5 Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics of enterprise reporting, BI road ahead.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Larissa T Moss and ShakuAtre – Business Intelligence Roadmap : The Complete Project Lifecycle for Decision Support Applications, Addison Wesley Information Technology Series, 2003. 2. R N Prasad, SeemaAcharya – Fundamentals of Business Analytics , Wiley India, 2011. 			
Reference Books: <ol style="list-style-type: none"> 1. David Loshin - Business Intelligence: The Savvy Manager's Guide, Publisher: Morgan Kaufmann, ISBN 1-55860-196-4. 2. Brian Larson - Delivering Business Intelligence with Microsoft SQL Server 2005, McGraw Hill, 2006. 3. Lynn Langit - Foundations of SQL Server 2008 Business Intelligence –Apress, ISBN13: 978- 1-4302-3324-4, 2011 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

04	16SCE332	Group-5	DATABASE SECURITY
Exam Hours:03		Exam Marks:100	
Module -1. Introduction: Introduction to Databases, Security Problems in Databases Security Controls Conclusions. Security Models 1: Introduction, Access Matrix Model, Take- Grant Model, Acten Model, PN Model, Hartson and Hsiao's Model, Fernandez's Model, Bussolati and Martella's Model for Distributed databases.			
Module -2 Security Models 2: Bell and LaPadula's Model, Biba's Model, Dion's Model, Sea View Model, Jajodia and Sandhu's Model, The Lattice Model for the Flow Control conclusion. Security Mechanisms: Introduction, User Identification/Authentication, Memory Protection, Resource Protection, Control Flow Mechanisms, Isolation, Security Functionalities in Some Operating Systems, Trusted Computer System, Evaluation Criteria.			
Module -3 Security Software Design: Introduction, A Methodological Approach to Security, Software Design, Secure Operating System Design, Secure DBMS Design, Security Packages, Database Security Design.			
Module -4 Statistical Database Protection & Intrusion Detection Systems: Introduction, Statistics, Concepts and Definitions, Types of Attacks, Inference Controls, evaluation Criteria for Control Comparison, Introduction IDES System, RETISS System, ASES System Discovery.			
Module -5 Models For The Protection Of New Generation Database Systems 1: Introduction, A Model for the Protection of Frame Based Systems, A Model for the Protection of Object-Oriented Systems, SORION Model for the Protection of Object-Oriented Databases. Models For The Protection Of New Generation Database Systems 2: A Model for the Protection of New Generation Database Systems, the Orion Model, Jajodia and Kogan's Model, A Model for the Protection of Active Databases Conclusions.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Database Security and Auditing, Hassan A. Afyoun i, India Edition, CENGAGE Learning, 2009. 2. Database Security, Castano, Second edition, Pearson Education. 			
Reference Books: <ol style="list-style-type: none"> 1. Database security by Alfred Basta, Melissa Zgola , CENGAGE learning.. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

05	16LNI253	Group-5	BIOINFORMATICS
Exam Hours:03		Exam Marks:100	
Module -1 INTRODUCTION : Need for Bioinformatics technologies – Overview of Bioinformatics technologies – Structural bioinformatics – Data format and processing – secondary resources- Applications – Role of Structural bioinformatics - Biological Data Integration System.			
Module -2 DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS: Bioinformatics data – Data ware housing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture- Applications in bioinformatics.			
Module -3 MODELING FOR BIOINFORMATICS : Hidden markov modeling for biological data analysis Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling.			
Module -4 PATTERN MATCHING AND VISUALIZATION: Gene regulation – motif recognition and motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences.			
Module -5 MICROARRAY ANALYSIS: Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding, spot extraction, normalization, filtering – cluster analysis – gene network analysis			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Yi-Ping Phoebe Chen (Ed), “Bio Informatics Technologies”, Springer Verlag, 2014.			
Reference Books: 1 NIL			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06	16SCE254	Group-5	COMPUTER VISION
Exam Hours:03		Exam Marks:100	
Module -1 CAMERAS: Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.			
Module -2 Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.			
Module -3 The Geometry of Multiple Views: Two Views, Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,			
Module -4 Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.			
Module -5 Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.			
Reference Books: 1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4 th edition, 2013.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

07	16SCS324	Group-5	ENTERPRISE APPLICATION PROGRAMMING
Exam Hours:03		Exam Marks:100	
Module -1			
<p>Web application and java EE 6: Exploring the HTTP Protocol, Introducing web applications, describing web containers, exploring web architecture models, exploring the MVC architecture. Working with servlets 3.0 Exploring the features of java servlet, Exploring new features in servlet 3.0, Exploring the servlet API, explaining the servlet life cycle, creating a sample servlet, creating a servlet by using annotation, working with servlet config and servlet context objects, working with the HTTP servlet request and HTTP servlet response interfaces, Exploring request delegation and request scope, implementing servlet collaboration.</p>			
Module -2			
<p>Handling sessions in servlet 3.0: Describing a session, introducing session tracking, Exploring the session tracking, mechanisms, using the java servlet API for session tracking, creating login application using session tracking. Implementing event handling Introducing events, Introducing event handling, working with the servlet events, developing the online shop web application. Working with java server pages: Introducing JSP technology, Exploring new features of JSP2.1, listing advantages of JSP over java servlet, Exploring the architecture of a JSP page, Describing the life cycle of a JSP page, working with JSP basic tags and implicit objects, working with the action tags in JSP, exploring the JSP unified EL, using functions with EL.</p>			
Module -3			
<p>Implementing JSP tag extensions: Exploring the elements of tag extensions, Working with classic tag handlers, Exploring the tag extensions, Working with simple tag handlers. Implementing java server pages standard tag library 1.2: Introducing JSTL, Exploring the tag libraries JSTL, working with the core tag library. Implementing filters: Exploring the need of filters, exploring the working of filters, exploring filters API, configuring a filter, creating a web application using filters, using initializing parameter in filters.</p>			
Module -4			
<p>Persistence Management and Design Patterns: Implementing java persistence using hibernate Introducing hibernate, exploring the architecture of hibernate, downloading hibernate, exploring HQL, understanding hibernate O/R mapping, working with hibernate, Implementing O/R mapping with hibernate. Java EE design patterns: Describing the java EE application architecture, Introducing a design patterns, discussing the role of design patterns, exploring types of patterns.</p>			
Module -5			
<p>Web Frameworks: Working with struts 2 Introducing struts 2, understanding actions in struts 2. Working with java server faces 2.0: Introducing JSF, Explaining the features of JSF, Exploring the JSF architecture, describing JSF elements, Exploring the JSF request processing life cycle. Working with spring 3.0: Introducing features of the spring framework, exploring the spring framework architecture, exploring dependency injection & inversion of control, exploring AOP with spring, managing transactions. Securing java EE 6 applications: Introducing security in java EE 6, exploring security mechanisms, implementing security on an application server.</p>			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1 Kogent learning solution: JAVA SERVER PROGRAMMING JAVA EE6(J2EE 1.6), Dreamtech press 2014			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

08	16SCS152	Group-5	MULTI CORE ARCHITECTURE AND PROGRAMMING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Multi-core Architecture Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading : Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.			
Module -2 Fundamental Concepts of Parallel Programming :Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control-based Concepts, Fence, Barrier, Implementation-dependent Threading Features			
Module -3 Threading APIs :Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.			
Module -4 OpenMP: A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance			
Module -5 Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006			
Reference Books: Nil			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

09	16SCS31	Group-5	MACHINE LEARNING TECHNIQUES
Exam Hours:03		Exam Marks:100	
Module -1 INTRODUCTION, CONCEPT LEARNING AND DECISION TREES: Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search			
Module -2 NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.			
Module -3 BAYESIAN AND COMPUTATIONAL LEARNING: Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model.			
Module -4 INSTANT BASED LEARNING AND LEARNING SET OF RULES: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions – Case- Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution			
Module -5 ANALYTICAL LEARNING AND REINFORCED LEARNING: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013.			
Reference Books: 1. Ethem Alpaydin, “Introduction to Machine Learning”, 2 nd Ed., PHI Learning Pvt. Ltd., 2013. 2. T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1 st edition, 2001.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

10	16SCN154	Group-5	CLOUD SECURITY
Exam Hours:03		Exam Marks:100	
Module -1 Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.			
Module -2 Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.			
Module -3 Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).			
Module -4 Data Center Operations: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, 8 Hours			
Module -5 Identity and Access Management: Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS , IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance”, Oreilly Media 2009.			
Reference Books: 1 Vic (J.R.) Winkler, “Securing the Cloud, Cloud Computer Security Techniques and Tactics”, Syngress, April 2011.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

11	16SFC22	Group-5	OPERATING SYSTEM SECURITY
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction: Secure Os, Security Goals, Trust Model, Threat Model, Access Control. Fundamentals: Protection system, Lampson’s Access Matrix, Mandatory protection system.			
Module -2			
Multics: Fundamentals, multics protection system models, multics reference model, multics security, multics vulnerability analysis.			
Module -3			
Security in ordinary operating system: UNIX security, windows security Verifiable security goals: Information flow, information flow secrecy, models, information flow integrity model, the challenges of trusted, process, covert channels.			
Module -4			
Security Kernels: The Security Kernels, secure communications, processor Scomp, Gemini secure OS, Securing commercial OS, Retrofitting security into a commercial OS, History Retrofitting commercial OS, Commercial era, microkernel era, UNIX era- IX, domain and type enforcement.			
Module -5			
Case study: Solaris Extensions Trusted extensions, access control, Solaris compatibility, trusted extensions, mediations process rights management, role based access control, trusted extensions, networking trusted extensions, multilevel services, trusted extensions administration.			
Case study: Building secure OS for Linux: Linux security modules, security enhanced Linux.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Trent Jaeger, Operating system security, Morgan & Claypool Publishers, 2008			
Reference Books:			
1. Michael Palmer, Guide to Operating system Security Thomson			
2. Andrew S Tanenbaum, Modern Operating systems, 3rd Edition			
3. Secure Operating Systems. John Mitchell. Multics-Orange Book-Claremont.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

12	16SCN153	Group-5	SOCIAL NETWORK ANALYSIS
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction to social network analysis and Descriptive network analysis: Introduction to new science of networks. Networks examples. Graph theory basics. Statistical network properties. Degree distribution, clustering coefficient. Frequent patterns. Network motifs. Cliques and k-cores.			
Module -2			
Network structure, Node centralities and ranking on network: Nodes and edges, network diameter and average path length. Node centrality metrics: degree, closeness and betweenness centrality. Eigenvector centrality and PageRank. Algorithm HITS.			
Module -3			
Network communities and Affiliation networks: Networks communities. Graph partitioning and cut metrics. Edge betweenness. Modularity clustering. Affiliation network and bipartite graphs. 1-mode projections. Recommendation systems.			
Module -4			
Information and influence propagation on networks and Network visualization: Social Diffusion. Basic cascade model. Influence maximization. Most influential nodes in network. Network visualization and graph layouts. Graph sampling. Low -dimensional projections			
Module -5			
Social media mining and SNA in real world: FB/VK and Twitter analysis: Natural language processing and sentiment mining. Properties of large social networks: friends, connections, likes, re-tweets.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books			
1. David Easley and John Kleinberg. "Networks, Crowds, and Markets: Reasoning About a Highly Connected World." Cambridge University Press 2010.			
2. Eric Kolaczyk, Gabor Csardi. "Statistical Analysis of Network Data with R (Use R!)". Springer, 2014.			
3. Stanley Wasserman and Katherine Faust. "Social Network Analysis. Methods and Applications." Cambridge University Press, 1994.			
Reference Books:			
NIL			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

13	16SSC14	Group-5	SERVICE ORIENTED ARCHITECTURE
Exam Hours:03		Exam Marks:100	
Module -1			
SOA BASICS : Software Architecture – Types of IT Architecture – SOA – Evolution – Key components – perspective of SOA – Enterprise-wide SOA – Architecture – Enterprise Applications – Solution Architecture for enterprise application – Software platforms for enterprise Applications – Patterns for SOA – SOA programming models.			
Module -2			
SOA ANALYSIS AND DESIGN: Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services – Technologies of SOA – SOAP – WSDL – JAX – WS – XML WS for .NET – Service integration with ESB – Scenario – Business case for SOA – stakeholder OBJECTIVES – benefits of SPA – Cost Savings.			
Module -3			
SOA GOVERNANCE: SOA implementation and Governance – strategy – SOA development – SOA governance – trends in SOA – event-driven architecture – software s a service – SOA technologies – proof-of-concept – process orchestration – SOA best practices.			
Module -4			
SOA IMPLEMENTATION: SOA based integration – integrating existing application – development of web services – Integration - SOA using REST – RESTful services – RESTful services with and without JWS – Role of WSDL,SOAP and Java/XML mapping in SOA – JAXB Data binding.			
Module -5			
APPLICATION INTEGRATION: JAX –WS 2.0 client side/server side development – Packaging and Deployment of SOA component – SOA shopper case study –WSDL centric java WS with SOA-J – related software – integration through service composition (BPEL) – case study - current trends.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Shankar Kambhampaly, “Service–Oriented Architecture for Enterprise Applications”,Wiley 2008.			
Reference Books:			
1 Mark D. Hansen, “SOA using Java Web Services”, Practice Hall, 2007.			
2. Waseem Roshen, “SOA-Based Enterprise Integration”, Tata McGraw-HILL, 2009.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

14	16SFC23	Group-5	SECURED PROGRAMMING
Exam Hours:03		Exam Marks:100	
Module -1 Validating all input & Designing secure programs: Command line and environment variables, File descriptors, names and contents, Web based application inputs, Locale selection and character encoding, Filtering represent able URIs, preventing cross site malicious input content, Forbidding HTTP Input to perform non-queries. Good security design principles: Securing the interface, separation of data and control. Minimize privileges: Granted, time, modules, resources etc, Using chroot, careful use of setuid/setgid, Safe default value and load initializations. Avoid race conditions, Trustworthy channels and trusted path, Avoiding semantics and algorithmic complexity attacks.			
Module -2 Declarations and Initializations and Expressions: Declare objects with appropriate storage durations, Identifier declaration with conflict linkage classifications, Using correct syntax for declaring flexible array member, Avoiding information leakage in structure padding, Incompatible declarations of same function or object. Dependence on evaluation order for side effects: Reading uninitialized memory and dereferencing null pointers, Modifying objects with temporary lifetime, Accessing variable through (pointer) incompatible type, Modifying constant objects and comparing padding data.			
Module -3 Integers and Floating Points: Wrapping of unsigned integers, Integer conversions and misrepresented data, Integer overflow and divide by zero errors, Shifting of negative numbers, Using correct integer precisions, Pointer conversion to integer and vice versa. Floating point values for counters: Domain and range errors in math functions, Floating point conversions and preserving precision.			
Module -4 Arrays , Strings and Memory Management: Out of bounds subscripts and valid length arrays, Comparing array pointers, Pointer arithmetic for non-array object, scaled integer, Modifying string literals, Space allocation for strings (Null terminator), Casting large integers as unsigned chars, Narrow and wide character strings and functions. Accessing freed memory: Freeing dynamically allocated memory, Computing memory allocation for an object, Copying structures containing flexible array members, Modifying object alignment by using realloc.			
Module -5 I/O, Signals and Error Handing: User input and format strings, Opening an pre-opened file, Performing device operations appropriate for files, Dealing with EOF, WEOF, Copying FILE object, Careful use of fgets, fgetws, getc, putc, putwc. Use of fsetops and fgetops, Accessing closed files. Using asynchronous safe functions and signal handlers: Shared objects and signal handlers, Using signal() within interruptible signal handlers, Returning computation exception signal handler. Using errno: check and set, Depending upon indeterminate values of errno, Handling standard library errors.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Robert C. Seacord, “The CERT ® C Coding Standard: 98 Rules for Developing Safe, Reliable, and Secure Systems, Second Edition”, Addison Wesley Professional, April 2014 2. David Wheeler, “Secure Programming for Linux and Unix HowTo”, Linux Documentation project, Aug 2004 			
Reference Books: <ol style="list-style-type: none"> 1 JohnViega, Matt Messier, “Secure Programming Cookbook for C and C++”, O’Reilly Media, 1st Edition, July 2003. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

01	16LNI331 / 16SCE241 / 16SCN151 / 16SCS323	Group-6	WIRELESS NETWORKS & MOBILE COMPUTING
Exam Hours:03		Exam Marks:100	
<p>Module -1 Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Wireless Networks : Global Systems for Mobile Communication (GSM and Short Service Messages (SMS): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Introduction to SMS, SMS Architecture, SM MT, SM MO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS, Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Introduction to WiMAX.</p>			
<p>Module -2 Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6</p>			
<p>Module -3 Mobile OS and Computing Environment : Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators</p>			
<p>Module -4 Building, Mobile Internet Applications: Thin client: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXML.</p>			
<p>Module -5 J2ME: Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010. 2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Raj kamal: Mobile Computing, Oxford University Press, 2007. 2. Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

02	18SCN424	Group-6	WEB MINING
Exam Hours:03		Exam Marks:100	
<p>Module -1 INTRODUCTION: Crawling and Indexing, Topic Directories, Clustering and Classification, Hyperlink Analysis, Resource Discovery and Vertical Portals, Structured vs. Unstructured Data Mining . INFRASTRUCTURE and WEB SEARCH – Crawling the web – HTML and HTTP Basics – Crawling Basics – Engineering Large Scale Crawlers- Putting together a Crawler- Boolean Queries and the Inverted Index – Relevance Ranking – Similarity Search.</p>			
<p>Module -2 INFORMATION RETRIEVAL: Information Retrieval and Text Mining – Keyword Search - Nearest-Neighbor Methods -Measuring Similarity - Web-Based Document Search - Document-Matching - Inverted Lists -Evaluation of Performance - Structure in a Document Collection - Clustering Documents by Similarity- Evaluation of Performance - Information Extraction - Patterns and Entities from Text- Co reference and Relationship Extraction - Template Filling and Database Construction</p>			
<p>Module -3 LEARNING I: Similarity and Clustering – Formulations and approaches- Bottom up and Top down Partitioning Paradigms – Clustering and Visualization via Embedding’s – Probabilistic Approaches to clustering – Collaborative Filtering, SUPERVISED LEARNING: The Supervised Learning Scenario, Overview of Classification Strategies, Evaluating Text Classifiers, Nearest Neighbor Learners, Feature Selection.</p>			
<p>Module -4 LEARNING II : SUPERVISED LEARNING – Bayesian Learners, Exploiting Hierarchy among Topics, Maximum Entropy Learners, Discriminative Classification, Hypertext Classification, SEMI SUPERVISED LEARNING-- Expectation Maximization, Labeling Hypertext Graphs and Co-training.</p>			
<p>Module -5 APPLICATIONS: Social Network Analysis- Social Sciences and Bibliometry – Page Rank and HITS – Shortcomings of coarse Grained Graph model- Enhanced Models and Techniques- Evaluation of Topic Distillation- Measuring and Modeling the Web – Resource Discovery – Collecting Important Pages Preferentially – Similarity Search Using Link Topology – Topical Locality and Focused Crawling – Discovering Communities- The Future of Web Mining.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Sholom Weiss, “Text Mining: Predictive Methods for Analyzing Unstructured Information”, Springer, 2005 2. Soumen Chakrabarti, “Mining the Web: Discovery Knowledge from Hypertext Data,” Elsevier Science 2003 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Min Song, Yi-fang Brrok Wu, “Handbook of Research on Text and Web Mining Technologies”, Vol I & II, Information Science Reference (IGI), 2009 2. K.P.Soman, ShyamDiwakar, V.Ajay, “Insight into Data Mining Theory and Practice ,” Prentice Hall of India Private Ltd 2006 3. Anthony Scime, “Web Mining Applications and Techniques”, Idea Group Publishing, 2005 4. Margret H.Dunham “DATA MINING - Introductory and Advanced Concepts”, Pearson Education, 2003. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

03	16SCN333	Group-6	WEB ENGINEERING
Exam Hours:03		Exam Marks:100	
<p>Module -1 Introduction: Motivation, Categories of web applications, Characteristics of web applications. Requirements Engineering: Introduction, Fundamentals, RE specifics in web engineering, Principles of RE for web applications, Adapting RE methods to web application development, Outlook. Modeling Web Application: Introduction, Fundamentals, Modeling specifics in web engineering, Modeling requirements, Content modeling, Hypertext modeling, Presentation modeling, Customization modeling, Methods and tools, Outlook.</p>			
<p>Module -2 Web Application Architectures: Introduction, Fundamentals, Specifics of web application architectures, Components of generic web application architecture, Layered architectures, Data-aspect architectures. Technology-Aware Web Application Design: Introduction, Web design from an evolutionary perspective, Presentation design, Interaction design, Functional design, Outlook. Technologies for Web Applications: Introduction, Fundamentals, Client/Server communication on the web, Client side technologies, Document-specific technologies, Server-side technologies, Outlook.</p>			
<p>Module -3 Testing Web Applications: Introduction, Fundamentals, Testing specifics in web engineering, Test approaches, Test scheme, Test methods and techniques, Test automation, Outlook. Operation and Maintenance of Web Applications: Introduction, Challenges following the launch of a web application, Content management, Usage analysis, Outlook. Web Project Management: From software project management to web project management, Challenges in web project management, Managing web teams, Managing the development process of a web application, Outlook.</p>			
<p>Module -4 The Web Application Development Process: Motivation, Fundamentals, Requirements for a web application development process, Analysis of the rational unified process, Analysis of extreme programming, Outlook. Usability of Web Applications: Motivation, What is usability? What characterizes the usability of web applications? Design guidelines, Web usability engineering methods, Web usability engineering trends, Outlook.</p>			
<p>Module -5 Performance of Web Applications: Introduction, What is performance? What characterizes performance of web applications, System definition and indicators, Characterizing the work load, Analytical techniques, Representing and interpreting results, Performance optimization methods, Outlook. Security for web Applications: Introduction, Aspects of security, Encryption, digital signatures, and certificates, Secure Client/Server interaction, Client security issues, Service provider security issues, Outlook. The Semantic Web: Fundamentals of the semantic web, Technological concepts, Specifics of semantic web applications, Tools, Outlook.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books: 1. Gerti Kappel, Birgit Proll, SiegfriedReich, Werner Retschitzgeger (Editors): Web Engineering, Wiley India, 2007.</p>			
<p>Reference Books: 1. Roger Pressman, David Lowe: Web Engineering: A Practitioner’s Approach, McGraw Hill, 2008.</p>			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

04	16SCN251	Group-6	WIRELESS SENSOR NETWORKS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction, Overview and Applications of Wireless Sensor Networks Introduction, Basic overview of the Technology, Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology. (Chapter 1: 1.1, 1.2, Chapter2: 2.1-2.6)			
Module -2 Basic Wireless Sensor Technology and Systems: Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies (Chapter3: 3.1-3.5, Chapter 4: 4.1-4.3)			
Module -3 MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study, IEEE 802.15.4 LR-WPANs Standard Case Study. Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs. (Chapter 5: 5.1-5.6, Chapter 6: 6.1-6.5)			
Module -4 Transport Control and Middleware for Wireless Sensor Networks: Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware. (Chapter 7: 7.1-7.4, Chap. 8: 8.1-8.4)			
Module -5 Network Management and Operating System for Wireless Sensor Networks: Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. Operating Systems for Wireless Sensor Networks: Introduction, Operating System Design Issues, Examples of Operating Systems. (Chapter 9: 9.1-9.5, Chapter 10: 10.1-10.3)			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, “Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014			
Reference Books: 1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010 2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.			
05	16SCN242	Group-6	SWITCHING & STATISTICAL

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

			MULTIPLEXING IN TELECOMMUNICATION
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: Evolution of Telecommunication, Simple Telephone Communication, Basics of a Switching System, Manual Switching System, Major Telecommunication Networks. Why Digital: Advantages of Digital Voice Networks, Digital Signal Processing, Disadvantages of Digital Voice Networks			
Module -2 Switching: Crossbar Switching, Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Crosspoint Technology, Crossbar Exchange Organization			
Module -3 Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Twostage, Three-stage and n-stage Networks. Digital Transmission and Multiplexing: Sampling, Quantization and Binary Coding, Quantization Noise, Companding, Differential Coding, Vocoders, Pulse Transmission, Line Coding, Time Division Multiplexing			
Module -4 Time Division Switching: Basic Division Space and Time Switching, Time Multiplexed Space and Time Switching, Combination Switching, Three-stage and n-stage Combination Switching			
Module -5 Traffic Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Thiagarajan Viswanathan: Telecommunication Switching Systems and Networks, PHI, 1992. 2. John.C.Bellamy: Digital Telephony, 3rd Edition, John Wiley and Sons Inc., 2002. 			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06	16LNI242	Group-6	WEB SERVICES
Exam Hours:03		Exam Marks:100	
Module -1			
Middleware: Understanding the middle ware, RPC and Related Middle ware, TP Monitors, Object Brokers, Message-Oriented Middleware.			
Module -2			
Web Services: Web Services Technologies, Web Services Architecture.			
Module -3			
Basic Web Services Technology: WSDL Web Services Description Language, UDDI Universal Description Discovery and Integration, Web Services at work interactions between the Specifications, Related Standards.			
Module -4			
Service Coordination Protocols: Infrastructure for Coordination Protocols, WSCoordination, WS-Transaction, Rosetta Net and Other Standards Related to Coordination Protocols.			
Module -5			
Service Composition: Basic of Service Composition, A New Chance of Success for Composition, Services Composition Models, Dependencies between Coordination and Composition, BPEL: Business Process Execution Language for Web Services, Outlook, Applicability of the Web Services, Web services as a Problem and a Solution : AN Example.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju: Web Services(Concepts ,Architectures and Applications), Springer International Edition 2009.			

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

07	16SCN23	Group-6	WIRELESS ADHOC NETWORKS
Exam Hours:03		Exam Marks:100	
Module -1 Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.			
Module -2 Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.			
Module -3 Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.			
Module -4 Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Routing Ad-hoc Wireless Networks.			
Module -5 Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1 C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2 nd Edition, Pearson Education, 2011			
Reference Books: 1 Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007. 2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004. 3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

08	16SFC322	Group-6	STEGANOGRAPHY AND DIGITAL WATERMARKING
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to Information hiding: Brief history and applications of information hiding, Principles of Steganography, Frameworks for secret communication, Security of Steganography systems, Information hiding in noisy data, Adaptive versus non adaptive algorithms, Laplace filtering, Using cover models, Active and malicious attackers, Information hiding in written text, Examples of invisible communications.			
Module -2 Survey of steganographic techniques: Substitution system and bit plane tools, Transform domain techniques, Spread spectrum and information hiding, Statistical Steganography, Distortion and code generation techniques, Automated generation of English text.			
Module -3 Steganalysis: Detecting hidden information, Extracting hidden information, Disabling hidden information, Watermarking techniques, History, Basic Principles, applications, Requirements of algorithmic design issues, Evaluation and benchmarking of watermarking system.			
Module -4 Survey of current watermarking techniques: Cryptographic and psycho visual aspects, Choice of a workspace, binary image, audio, video. Formatting the watermark beds: Digital watermarking schemes, Spread Spectrum, DCT (Discrete Cosine Transform), Domain and Quantization schemes, Watermarking with side information, Robustness to temporal and geometric distortions.			
Module -5 Data Right Management: DRM Products and Laws, Fingerprints, Examples, Protocols and Codes, Boneh-Shaw finger printing Scheme, Steganography and watermarking applications, Military, Digital copyright protection and protection of intellectual property.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Stefan Katzenbelsser and Fabien A. P. Petitcolas, Information hiding techniques for Steganography and Digital Watermarking, ARTECH House Publishers, January 2004. 2. I.J. Cox, M.L. Miller, J.Fridrich and T.Kalker, Digital Water Marking and Steganography, 2nd Edition, Morgan Kauffman Publishers, 2008. 3. Johnson, Neil F. / Duric, Zoran / Jajodia, Sushil G , Information Hiding: Steganography and Watermarking -Attacks and Countermeasures (Advances in Information Security, Volume 1), 2001. 			
Reference Books: <ol style="list-style-type: none"> 1 Peter Wayner , "Disappearing Cryptography: Information Hiding, Steganography and Watermarking 2/e", Elsevier. 2. Practical Cryptography, N.Ferguson and B.Schneier, Wiley Publishing Inc., 2003. 3. Bolle, Connell et. al., "Guide to Biometrics", Springer 4. John Vecca, "Computer Forensics: Crime scene Investigation", Firewall Media 5. Christopher L.T. Brown, "Computer Evidence: Collection and Preservation", Firewall Media 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

09	16SSE21/ 16SCS332	Group-6	SOFTWARE PROJECT PLANNING & MANAGEMENT
Exam Hours:03		Exam Marks:100	
Module -1			
Metrics: Introduction, The Metrics Roadmap, A Typical Metrics Strategy, What Should you Measure?, Set Targets and track Them, Understanding and Trying to minimize variability, Act on data, People and Organizational issues in Metrics Programs, Common Pitfalls to watch out for in Metrics Programs, Matrices implementation checklists and tools, Software configuration management: Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation.			
Module -2			
Risk Management: Introduction, What is risk management and why is it important?, Risk management cycle, Risk identification: common tools and techniques, Risk Quantifications, Risk Monitoring, Risk Mitigation, Risks and Mitigation in the context of global project teams, some practical techniques risk management, Metrics in risk management. Project Planning and Tracking: Components of Project Planning and Tracking, The “What “ Part of a Project Plan, The “What Cost “ Part of a Project Plan, The “When “ Part of Project Planning, The “How “ Part of a Project Planning: Tailoring of Organizational Processes For the Project, The “ By Whom “ Part of the Project Management Plan : Assigning Resources, Putting it all together : The Software Management Plan, Activities Specific to Project Tracking, Interfaces to the Process Database. Project Closure: When Does Project Closure Happen?. Why Should We Explicitly do a Closure?, An Effective Closure Process, Issues that Get Discussed During Closure, Metrics for Project Closure, Interfaces to the Process Database.			
Module -3			
Software Requirements gathering: Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering, outputs and quality records from the requirements phase, skill sets required during requirements phase, differences for a shrink-wrapped software, challenges during the requirements management phase, Metrics for requirements phase. Estimation: What is Estimation? when and why is Estimation done?, the three phases of Estimation, Estimation methodology, formal models for size Estimation, Translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation , Metrics for the Estimation processes. Design and Development Phases: Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint, design for reusability, technology choices/ constraints, design to standards, design for portability, user interface issues, design for testability, design for diagnose ability, design for maintainability, design for install ability, inter-operability design, challenges during design and development phases, skill sets for design and development, metrics for design and development phases.			
Module -4			
Project management in the testing phase: Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management structures for testing in global teams, metrics for testing phase. Project management in the Maintenance Phase: Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, skill sets for people in the maintenance phase, estimating size, effort, and people resources for the maintenance phase, advantages of using geographically distributed teams for the maintenance phase, metrics for the maintenance phase.			
Module -5			
Globalization issues in project management: Evolution of globalization, challenges in building global teams, Models for the execution of global projects, some effective management techniques for managing global teams. Impact of the internet on project management: Introduction, the effect of internet on project management, managing projects for the internet, Effect on the project management activities. People focused			

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process models: Growing emphasis on people centric models, people capability maturity model(P-CMM), other people focused models in the literature, how does an organization choose the models to use?

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ramesh Gopaldaswamy: "Managing Global Projects ", Tata McGraw Hill, 2013.

Reference Books:

1. Watts Humphrey, "Managing the Software Process ", Pearson Education, New Delhi, 2000
2. Pankaj Jalote, "Software Project Management in practice", Pearson Education, New Delhi, 2002.

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As per 2017 Regulation

10	16SFC334	Group-6	SOFTWARE METRICS & QUALITY ASSURENCE
Exam Hours:03		Exam Marks:100	
Module -1 What Is Software Quality: Quality: Popular Views, Quality Professional Views, Software Quality, Total Quality Management and Summary. Fundamentals Of Measurement Theory: Definition, Operational Definition, And Measurement, Level Of Measurement, Some Basic Measures, Reliability And Validity, Measurement Errors, Be Careful With Correlation, Criteria For Causality, Summary. Software Quality Metrics Overview: Product Quality Metrics, In Process Quality Metrics, Metrics for Software Maintenance, Examples For Metrics Programs, Collecting Software Engineering Data.			
Module -2 Applying The Seven Basic Quality Tools In Software Development : Ishikawa’s Seven Basic Tools, Checklist, Pareo Diagram, Histogram, Run Charts , Scatter Diagram, Control Chart, Cause And Effect Diagram. The Rayleigh Model: Reliability Models, The Rayleigh Model Basic Assumptions, Implementation, Reliability And Predictive Validity.			
Module -3 Complexity Metrics And Models: Lines Of Code, Halstead’s Software Science , Cyclomatic Complexity Syntactic Metrics, An Example Of Module Design Metrics In Practice . Metric And Lessons Learned For Object Oriented Projects: Object Oriented Concepts And Constructs, Design And Complexity Metrics, Productivity Metrics, Quality And Quality Management Metrics, Lessons Learned For object oriented Projects.			
Module -4 Availability Metrics: Definition And Measurement Of System Availability, Reliability Availability And Defect Rate, Collecting Customer Outage Data For Quality Improvement, In Process Metrics For Outage And Availability . Conducting Software Project Assessment : Audit Ad Assessment , Software Process Maturity Assessment And Software Project Assessment , Software Process Assessment A Proponed Software Project Assessment Method.			
Module -5 Dos And Don’ts Of Software Process Improvement : Measuring Process Maturity, Measuring Process Capability, Staged Versus Continuous Debating Religion, Measuring Levels Is Not Enough, Establishing The Alignment Principle , Take Time Getting Faster, Keep it Simple Or Face Decomplexification, Measuring The Value Of Process Improvement , Measuring Process Compliance , Celebrate The Journey Not Just The Destination. Using Function Point Metrics to Measure Software Process Improvement: Software Process Improvement Sequences, Process Improvement Economies, Measuring Process Improvement at Activity Levels			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: 1. Stephen H Khan: Metrics and Models in Software Quality Engineering, Pearson 2nd edition 2013.			
Reference Books: 1 Norman E-Fentor and Share Lawrence Pflieger.” Software Metrics”. International Thomson Computer Press, 1997. 2. S.A.Kelkar,”Software quality and Testing, PHI Learning, Pvt, Ltd., New Delhi 2012. 3. Watts S Humphrey, “Managing the Software Process”, Pearson Education Inc, 2008. 4. Mary Beth Chrissis, Mike Konrad and Sandy Shrum, “CMMI”, Pearson Education(Singapore) Pte Ltd, 2003 5. Philip B Crosby, " Quality is Free: The Art of Making Quality Certain ", Mass Market, 1992.			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

11	16SFC244	Group-6	TRUST MANAGEMENT IN E-COMMERCE
Exam Hours:03		Exam Marks:100	
Module -1 Introduction to E-Commerce: Network and E-Commerce, Types of E-Commerce. Ecommerce Business Models: B2C, B2B, C2C, P2P and M-commerce business models. Ecommerce Payment systems: Types of payment system, Credit card E-Commerce transactions, B2C E-Commerce Digital payment systems, B2B payment system.			
Module -2 Security and Encryption: E-Commerce Security Environment, Security threats in Ecommerce environment, Policies, Procedures and Laws.			
Module -3 Inter-organizational trust in E-Commerce: Need, Trading partner trust, Perceived benefits and risks of E-Commerce, Technology trust mechanism in E-Commerce, Perspectives of organizational, economic and political theories of inter-organizational trust, Conceptual model of inter-organizational trust in E-Commerce participation.			
Module -4 Introduction to trusted computing platform: Overview, Usage Scenarios, Key components of trusted platform, Trust mechanisms in a trusted platform.			
Module -5 Trusted platforms for organizations and individuals: Trust models and the E-Commerce domain.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books: <ol style="list-style-type: none"> 1. Kenneth C. Laudon and Carol Guercio Trave, Study Guide to E-Commerce Business Technology Society, Pearson Education, 2005. 2. Pauline Ratnasingam, Inter-Organizational Trust for Business-to-Business E- Commerce,IRM Press, 2005. 			
Reference Books: <ol style="list-style-type: none"> 1. Siani Pearson, et al, Trusted Computing Platforms: TCPA Technology in Context, Prentice Hall PTR, 2002. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
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12	16SSC23	Group-6	SOFTWARE DESIGN PATTERNS
Exam Hours:03		Exam Marks:100	
Module -1 Introduction: what is a design pattern? describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. What is object-oriented development? , key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm			
Module -2 Analysis a System: overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation, discussions and further reading.			
Module -3 Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.			
Module -4 Interactive systems and the MVC architecture: Introduction , The MVC architectural pattern, analyzing a simple drawing program , designing the system, designing of the subsystems, getting into implementation , implementing undo operation , drawing incomplete items, adding a new feature , pattern based solutions.			
Module -5 Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays.			
Question paper pattern: <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books <ol style="list-style-type: none"> 1. Object-oriented analysis, design and implementation, brahma dathan, sarnath rammath, universities press,2013. 2. Design patterns, Erich Gamma, Richard Helan, Ralph Johman , John Vlissides, PEARSON Publication,2013. 			
Reference Books: <ol style="list-style-type: none"> 1. Frank Bachmann, RegineMeunier, Hans Rohnert “Pattern Oriented Software Architecture” – Volume 1, 1996. 2. William J Brown et al., "Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998. 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
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13	16SCS252	Group-6	TRENDS IN ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING
Exam Hours:03		Exam Marks:100	
<p>Module -1 Role of AI in Engineering, AI in daily life, Intelligence and AI, Different Task Domains of AI, History and Early Works of AI, History of AI, Programming Methods, Limitations of AI, Agent, Performance Evaluation, Task environment of an Agent, Agents Classification, Agent Architecture Logic Programming, Logic Representation, Propositional Logic, Predicate Logic and Predicate Calculus, Horn Clauses, Well formed Formula, Computable functions and predicate, Quantifiers, Universe of discourse, Applications of Predicate Logic, Unification, Resolution, Conjunctive Normal Form, conversion to normal form or clausal form.</p>			
<p>Module -2 Fundamental Problem of Logic: Logic Inadequacy: Fundamental Problem of Logic-Monotonicity with “Flying Penguin” example, General disadvantage of monotonicity property in logic, logic in search space problem, logic in decidability and Incompleteness, Logic in Uncertainty Modelling, Knowledge representation: Knowledge, Need to represent knowledge, Knowledge representation with mapping scheme, properties of a good knowledge base system, Knowledge representation issues, AND-OR graphs, Types of knowledge, Knowledge representation schemes, semantic nets, Frames, conceptual graphs, conceptual dependence theory, script, weak and strong slot filler. Reasoning: Types of Reasoning, Methods of reasoning, Application of Reasoning, Forward and Backward Reasoning.</p>			
<p>Module -3 Search Techniques: Search, Representation techniques, Categories of Search, Disadvantage of state space search, Issues in design of search programs, General Search examples, Classification of search diagram representation, Hill climbing method and Hill climbing search, Simulated Annealing, Best-First Search, Branch and Bound Search, A* search Game Playing: Two player games, Minmax Search, Complexity of Minmax algorithm, Alpha-Beta Pruning Planning: Necessity of planning, Components of Planning, Planning Agents, Plan-generating schemes, Algorithm for planning, Planning Representation with STRIPS, BLOCKS WORLD, difficulties with planning.</p>			
<p>Module -4 Fuzzy Sets and Uncertainties: Fuzzy set and fuzzy logic, set and fuzzy operators, Extended fuzzy operations, Fuzzy relations, Properties of fuzzy relations, Fuzzy system and design, Linguistic hedges, Syntax for IF and Then rules, Types of fuzzy rule based system, Fuzzy linguistic controller, Fuzzy Inference, Graphical techniques of Inference, How, Fuzzy logic is used, Fuzzification, De-fuzzification. Unique features of Fuzzy Logic, Application of Fuzzy Logic, Fuzzy logic uncertainty and probability, Advantages and Limitations of Fuzzy logic and Fuzzy Systems.</p>			
<p>Module -5 Advancement of AI: Expert System, Expert System structure, Knowledge acquisition, Knowledge representation, Inference control mechanism, User interface, Expert System Shell, Knowledge Representation, Inference Mechanism, Developer Interface and User Interface, Characteristics of Expert system, Advantages of an expert system, Production System, Artificial Neural Networks, Characteristics of Neural Networks, Architecture of neural networks, Types of neural networks, Application of neural networks.</p>			
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
<p>Text Books: 1. Anindita Das Battacharjee, Artificial Intelligence and Softcomputing for Beginners, Shroff Publishers, 2nd edition.</p>			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Elaine Rich, Kevin Knight, Shivashanka B Nair: Artificial Intelligence, Tata McGraw Hill 3rd edition. 2013 2. Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013. 3. Neural Networks, Fuzzy Logic and Genetic Algorithms by S. Rajasekaran, G. A. VijayalakshmiPai, PHI publication. 4. Nils J. Nilsson: “Principles of Artificial Intelligence”, Elsevier, ISBN-13: 9780934613101 			

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PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

14	16SSE41	Group-6	SOFT COMPUTING
Exam Hours:03		Exam Marks:100	
Module -1			
Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Fundamental concept of ANN, Evolution, basic Model of ANN, Terminologies used in ANN, MP model, Hebb model.			
Module -2			
Perceptron Network: Adaptive linear neuron, Multiple adaptive linear neurons, Back propagation Network (Theory, Architecture, Algorithm for training, learning factors, testing and applications of all the above NN models).			
Module -3			
Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.			
Module -4			
Defuzzification: Fuzzy decision making, and applications.			
Module -5			
Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.			
Question paper pattern:			
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module. 			
Text Books:			
1. Principles of Soft computing, Shivanandam, Deepa S. N, Wiley India, ISBN 13: 788126527410, 2011			
Reference Books:			
1 Neuro-fuzzy and soft computing, J.S.R. JANG, C.T. SUN, E. MIZUTANI, Phi (EEE edition), 2012.			