Group No.	Course Code	Course Title	UNIQUE CODE
1	20SCS324	Multicore Architecture	201MC001
1	20LNI334	Network Routing Algorithm	201MC002
1	20SCS251	Image Processing and Machine Vision	201MC003
1	20SCE324	Agile Technologies	201MC004
1	20SAM331	Game Theory	201MC005
1	20SIT334	Advances in Operating Systems	201MC006
1	20SAM14	Data Science	201MC007
1	20SAM13	Cognitive Science	201MC008
1	20MCA252	Data Mining and Business Intelligence	201MC009
1	20MCA253	Enterprise Resource Planning	201MC010

Group No.	Course Code	Course Title	UNIQUE CODE
2	20SIS15	Embedded Computing	202MC001
2	20SCN13	Information and Network Security	202MC002
2	20SIT13	Data Compression	202MC003
2	20SIT254	Software Project Planning & Management	202MC004
2	20SSE324	Supply Chain Management	202MC005
2	20LNI254	Advanced Cryptography	202MC006
2	20SSE14	Service Oriented Architecture	202MC007
2	20SSE243	Information Retrieval	202MC008
2	20SFC251	Data mining & Data warehousing	202MC009
2	20MCA263	Mobile Application Development	202MC010
2	20MCA264	Distributed operating System	202MC011

Group No.	Course Code	Course Title	UNIQUE CODE
3	20SCN242	Switching & Statistical Multiplexing in	203MC001
3	20SCN321	Computer System Performance Analysis	203MC002
3	20SFC243	Information Network Policies in Industry	203MC003
3	20SCN332	Protocol Engineering	203MC004
3	20SAM334	Speech Processing	203MC005
3	20SSE12	Advances in Software Testing	203MC006
3	20SFC253	Enterprise Application Programming	203MC007
3	20SCS244	Pattern Recognition	203MC008
3	20SCS13	Advances in Data Base Management System	203MC009
3	20MCA262	Artificial Intelligence	203MC010

4	20SFC254	Machine Learning Techniques	204MC001
4	20LNI324	Wireless Sensor Networks	204MC002
4	20LNI332	Social Network Analysis	204MC003
4	20SSE13	Object Oriented Software Engineering	204MC004
4	20SIS14	Internet of Things and Applications	204MC005
4	20SIS12	Cloud Computing	204MC006
4	20SSE23	Software Design Patterns	204MC007
4	20SAM333	Multidisciplinary Design Optimization	204MC008
4	20LNI252	Software Agents	204MC009
5	20SCS31	Deep Learning	205MC001
5	20LNI331	Wireless Networks & Mobile Computing	205MC002
5	20SCN334	Web Mining	205MC003
5	20SAM324	Software Defined Networks	205MC004
5	20SCS332	Robotics & Automation	205MC005
5	20LNI333	Cloud Security	205MC006
5	20SAM243	Probabilistic Graphical Models	205MC007
5	20SFC244	Trust Management in E-Commerce	205MC008
5	20SCS14	Advanced Algorithms	205MC009
5	20MCA31	Data Analytics using Python	205MC010
6	20SCS242	Natural Language Processing & Text Mining	206MC001
6	20SFC323	Mobile Device Forensics	206MC002
6	20SIT244	Cyber Security &Cyber law	206MC003
6	20SAM22	Soft & Evolutionary Computing	206MC004
6	20LNI251	Managing Big Data	206MC005
6	20SCS23	Block Chain Technology	206MC006
6	20SFC252	Data Base Security	206MC007
6	20SCE253	Decision Support System	206MC008
6	20SAM332	Semantic Web and Social Networks	206MC009
6	20MCA353	Wireless Ad Hoc Networks	206MC010
6	20MCA345	NOSQL	206MC011
6	20MCA343	Digital Marketing	206MC012

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(Group-1):   Course Code20SCS324
Multicore Architecture

Exam Hours: 3 hours	Exam Marks(Maximum):100

Module-1

Classes of Computers, Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance. Single core to Multi-core architectures: Limitations of Single Core Processors - The Multi core era – Case Studies of Multi core Architectures. 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.

Module-2

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data 20082020 / 37 Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion. Threading and Parallel Programming Constructs: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

Module-3

TLP AND MULTIPROCESSORS : Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues -Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

Module-4

A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Datarace 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. OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

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 Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

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	Title of the book	Author Name	Publisher's Name	Publication year
Textbook/Reference Books				
Textbook(s):				
1	Multicore Programming, Increased Performance through Software	Shameem Akhter and Jason	Intel Press	2006
2	An Introduction to Parallel Programming	Peter S Pacheco, Morgan/Kuffman	Elsevier	2011
3	Multicore Application Programming for Windows, Linux, Oracle, Solaris	Darryl Gove, Pearson	Darryl Gove, Pearson	2011
Reference Book(s):				
4	Parallel Programming in C with MPI and OpenMP	Michael J Quinn	Tata McGraw Hill	2003

(Group-1): Course Code 20LNI334 Network Routing Algorithm	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

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

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 instanceof 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

Module-3

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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 ford Dimensions, Extending TwoDimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions.

Module-4
ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS: Wireless networking basic aspects, Basic routing concepts, AD hoc routing, Mesh routing, Vehicular routing, Sensor routing

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.

Question paper pattern:
• The question paper will have ten questions. • Each full question is for 20 marks. • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. • Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

	Title of the book	Author Name	Publisher's Name	Publication year
1	Network Routing: Algorithms, Protocols, and Architectures	DeepankarMedhi and KarthikeyanRama	Elsevier	2007
2	Advanced Routing Protocols for Wireless Networks	Miguel Elias M. Campista and Marcelo G. Rubinstein	John Wiley & Sons, Inc	2014

Reference Book(s):

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

(Group-1): Course Code 20SCS251 Image Processing and Machine Vision	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction and Digital Image Fundamentals Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels

Module-2

Image Enhancement in the Spatial and Frequency Domain Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Grey Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression 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 PositionInvariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing Discontinuity based segmentation, similaritybased segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms

Module-5

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Object Representation and description and Computer Vision Techniques Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods	Pearson Education, 3rd edition	2006
2	Computer Vision: A Modern Approach	David A. Forsyth, Jean Ponce	Prentice Hall	2002
3	Fundamental of Digital Image	A.K. Jain	PHI	1988
Reference Book(s):				
4	Digital Image Processing	W.K. Pratt	CRC Press	2013

(Group-1): Course Code 20SCE324 Agile Technologies	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	

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: "DoneDone", 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, TestDriven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	The Art of Agile Development	James shore, Chromatic	O'Reilly	2007
Reference Book(s):				
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

(Group-1): Course Code20SAM331 Game Theory	
Exam Hours: 3 hours	Exam Marks(Maximum):100
Module-1	
INTRODUCTION 9 Elements of Game Play – Artificial Intelligence – Getting Input from the Player - Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop.	
Module-2	

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3D GRAPHICS FOR GAME PROGRAMMING 9 Coordinate Systems, Ray Tracing, Modeling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces.

Module-3

GAME DESIGN PRINCIPLES 9 Character Development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding, Case study : Tetris.

Module-4

GAMING ENGINE DESIGN 9 Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects, and Physics, Case study : The Sims

Module-5

GAME DEVELOPMENT 9 Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games. Case study: Mine craft.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics	David H. Eberly	Second Edition, Morgan Kaufmann	2010
2	3D Graphics for Game Programming	Jung Hyun Han, Chapman and Hall	CRC, First Edition	2011
Reference Book(s):				
1	Beginning Game Programming‖, Course Technology	Jonathan S. Harbour	Third Edition PTR	2009
2	Fundamentals of Game Design	Ernest Adams and Andrew Rollings	Pearson Education Third Edition	2014
3	Level Up: The Guide to Great Video Game Design	Scott Rogers	Wiley, First Edition	2010

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4	Game Design: Principles, Practice, and Techniques The Ultimate Guide for the Aspiring Game Designer	Jim Thompson, Barnaby Berbank-Green, and NicCusworth	Wiley, First Edition	2008

(Group-1): Course Code 20SIT334 Advances in Operating Systems	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 PreclsSl) 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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

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Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Text Book(s):				
1	Operating Systems: Internals and Design Principles	William Stallings	Prentice Hall, 6th Edition	2013
2	Operating Systems	Gary Nutt, Pearson	Pearson, 3rd Edition	2014
Reference Book(s):				
1.	Operating System Concepts	Silberschatz, Galvin, Gagne	Wiley, 8th Edition	2008
2	Operating Systems, Design and Implementation	Andrew S. Tanenbaum, Albert S. Woodhull,	Prentice Hall, 3rd Edition	2006
3	Distribute Operating Systems, Concept and Design	Pradeep K Sinha	PHI	2007

(Group-1): Course Code 20SAM14 Data Science	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. NeededStatistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model, - Introduction to R

Module-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (kNN), k-means

Module-3

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Module-4

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

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Module-5
Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Doing Data Science	Cathy O'Neil and Rachel Schutt, Straight Talk from The Frontline	O'Reilly	2014
2	Mining of Massive DatasetsV2.1	Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Cambridge University Press, 2nd Edition	2014
Reference Book(s):				
1	Data Mining: Concepts and Techniques	Jiawei Han, MichelineKamber and Jian Pei	Morgan Kauffman, Third Edition,	2012

(Group-1): Course Code 20SAM13 Cognitive Science	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
The prehistory of cognitive science, The reaction against behaviorism in psychology, The theory of computation and the idea of an algorithm, Linguistics and the formal analysis of language, Information-processing models in psychology, The discipline matures: Three milestones: Language and micro-worlds, How do mental images represent?, An interdisciplinary model of vision	

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Module-2
The turn to the brain : Cognitive systems as functional systems , The anatomy of the brain and the primary visual pathway , Extending computational modeling to the brain , Mapping the stages of lexical processing , THE INTEGRATION CHALLENGE, Cognitive science and the integration challenge; Cognitive science: An interdisciplinary endeavor, Levels of explanation: The contrast between psychology and neuroscience, The integration challenge, Local integration I: Evolutionary psychology and the psychology of reasoning, Local integration II: Neural activity and the BOLD signal

Module-3
INFORMATION-PROCESSING MODELS OF THE MIND , Physical symbol systems and the language of thought ; The physical symbol system hypothesis , From physical symbol systems to the language of thought , The Chinese room argument , Applying the symbolic paradigm ; Expert systems, machine learning, and the heuristic search hypothesis , ID3: An algorithm for machine learning , WHISPER: Predicting stability in a block world

Module-4
Neural networks and distributed information processing ; Neurally inspired models of information processing , Single-layer networks and Boolean functions , Multilayer networks, Information processing in neural networks: Key features, Neural network models of cognitive processes; Language and rules: The challenge for information-processing models, Language learning in neural networks, Object permanence and physical reasoning in infancy, Neural network models of children's physical reasoning

Module-5
THE ORGANIZATION OF THE MIND , How are cognitive systems organized?; Architectures for intelligent agents , Fodor on the modularity of mind , The massive modularity hypothesis , Strategies for brain mapping ; Structure and function in the brain , , Studying cognitive functioning: Techniques from neuroscience , Combining resources I: The locus of selection problem , Combining resources II: Networks for attention , From data to maps: Problems and pitfalls.

Question paper pattern:
• The question paper will have ten questions.   • Each full question is for 20 marks.   • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.   • Each full question with sub questions will cover the contents under a module.   • Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cognitive Science :An Introduction to the Science of the Mind	Jose Luis Bermudez	Cambridge University Press, Second Edition	2020
Reference Book(s):				

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1	Cognition	Reisberg	W. W. Norton & Co. price	2005
2	Why Everyone (Else) Is a Hypocrite	Kurzban	Princeton University Press; ISBN: 978-0- 691- 15439-8.,	2012

Group-1 **Course title : Data Mining with Business Intelligence**	
Course Code: 20MCA252	Exam Hours:03

Module-1
Overview and concepts Data Warehousing and Business Intelligence: Why reporting and Analysing data, Raw data to valuable information-Lifecycle of Data - What is Business Intelligence - BI and DW in today's perspective - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data 1marts - Overview of the components - Metadata in the data warehouse - Need for data warehousing - Basic elements of data warehousing - trends in data warehousing. **The Architecture of BI and DW** BI and DW architectures and its types - Relation between BI and DW - OLAP (Online analytical processing) definitions - Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations.

Module-2
Introduction to data mining (DM): Motivation for Data Mining - Data Mining-Definition and Functionalities – Classification of DM Systems - DM task primitives - Integration of a Data Mining system with a Database or a Data Warehouse - Issues in DM – KDD Process Data Pre-processing:Why to pre-process data? - Data cleaning: Missing Values, Noisy Data - Data Integration and transformation - Data Reduction: Data cube aggregation, Dimensionality reduction - Data Compression - Numerosity Reduction - Data Mining Primitives - Languages and System Architectures: Task relevant data - Kind of Knowledge to be mined - Discretization and Concept Hierarchy.

Module-3
Concept Description and Association Rule Mining What is concept description? - Data Generalization and summarization-based characterization - Attribute relevance - class comparisons Association Rule Mining: Market basket analysis - basic concepts - Finding frequent item sets: Apriori algorithm - generating rules – Improved Apriori algorithm – Incremental ARM – Associative Classification – Rule Mining.

Module-4
Classification and prediction:

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What is classification and prediction? – Issues regarding Classification and prediction: Classification methods: Decision tree, Bayesian Classification, Rule based, CART, Neural Network Prediction methods: Linear and nonlinear regression, Logistic Regression. Introduction of tools such as DB Miner /WEKA/DTREG DM Tools.
Module-5
Data Mining for Business Intelligence Applications:
Data mining for business Applications like Balanced Scorecard,   Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM etc., Data Analytics Life Cycle: Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.
Textbook
1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 2. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc. 3. PaulrajPonnian, "Data Warehousing Fundamentals", John Willey. 4. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education. 5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India

Group-1 Enterprise Resource Planning	
Course Code:20MCA253	Exam Hours:03
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	
ERP Implementation: Implementation of Life Cycle, Implementation Methodology, Hidden Costs, Organizing Implementation, Vendors, Consultants and Users, Contracts, Project Management and Monitoring	
Module-3	
Business Modules: Business Modules in an ERP Package, Finance, Manufacturing, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution	
Module-4	
ERP Market: ERP Market Place, SAP AG, People Soft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD, System Software Associates.	
Module-5	
ERP–Present And Future: Turbo Charge the ERP System, EIA, ERP and E–Commerce, ERP and Internet, Future Directions in ERP.	
Textbooks	
1. Sunil Chopra and Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson/PHI, 3rd Edition, 2007	

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2. Alexis Leon, "ERP Demystified", Tata McGraw Hill, 1999.
3. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, "Concepts in Enterprise Resource Planning", Thomson Learning, 2001.
Reference
1.Vinod Kumar Garg and N.K .Venkata Krishnan, "Enterprise Resource Planning concepts and Planning", Prentice Hall, 1998.   2. Jose Antonio Fernandz, " The SAP R /3 Hand book", Tata McGraw Hill

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(Group-2): Course Code 20SIS15 Embedded Computing	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 systemsnetwork 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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year

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Textbook(s):				
1	Embedded Systems: Architecture, Programming, and Design	Raj Kamal	Tata McGraw hill, 2nd edition	2013
Reference Book(s):				
1	Computer as Components, Principles of Embedded Computing System Design	Marilyn Wolf	Elsevier, 3rd edition	2014

(Group-2): Course Code 20SCN13 Information and Network Security	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and BruteForce 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

Module-2

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 Zp, elliptic curves overGF(2m), 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.

Module-3

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.

Module-4

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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

Module-5

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cryptography and Network Security	William Stallings	Pearson, 6 th edition	2013
Reference Book(s):				
1	Cryptography and Information Security	V K Pachghare	PHI, 2nd edition	2015

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(Group-2): Course Code 20SIT13 Data Compression	
Exam Hours: 3 hours	**Exam Marks(Maximum):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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Introduction to data compression,	Khalid sayood	Elsevier, 4 th edition	2014
Reference Book(s):				
1	Data compression, The complete reference	David Salomon	Springer, 4 th edition	2014

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(Group-2): Course Code 20SIT254 Software Project Planning & Management	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 shrinkwrapped 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, interoperability 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

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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 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 is for 20 marks.
• There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
• Each full question with sub questions will cover the contents under a module.
• Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Managing Global Projects	Ramesh Gopalaswamy	Tata McGraw Hill	2013
Reference Book(s):				
1	Managing the Software Process	Watts Humphrey	Pearson Education	2000
2	Software Project Management in practice	PankajJalote	Pearson Education	2002

(Group-2): Course Code 20SSE324 Supply Chain Management	
Exam Hours: 3 hours	**Exam Marks(Maximum):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	

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Supply Chain Management – Strategy, Planning and Operation	Sunil Chopra and Peter Meindl	Pearson/PHI, 3rd Edition	2007
2	The management of Business Logistics – A supply Chain Perspective	Coyle, Bardi, Longley	Thomson Press	2006
3	Supply Chain Management	Janat Shah	Pearson Publication	2008
Reference Book(s):				
1	Supply Chain Logistics Management	Donald J Bowersox, Dand J Closs, M Bixby Coluper	TMH, Second Edition	2008
2	Principles of Supply Chain Management A Balanced Approach	Wisner, Keong Leong and KeahChoon Tan	Thomson Press	2005
3	Designing and Managing the Supply Chain – Concepts	David Simchi-Levi et al	ISBN-13:978-0072357561, MGH,3rd Edition	2019

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(Group-2): Course Code 20LNI254 Advanced Cryptography	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Number Theory: Introduction to number theory, Overview of modular arithmetic, discrete logarithms, and primality/factoring, Euclid's algorithm, Finite fields, Prime numbers, Fermat's and Euler's theorem Testing for primality.

Module-2

Symmetric & Asymmetric Cryptography: Classical encryption techniques, Block cipher design principles and modes of operation, Data encryption standard, Evaluation criteria for AES, AES cipher, Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange, Elliptic curve arithmetic-Elliptic curve cryptography

Module-3

.Authentication functions: MAC ,Hash function, Security of hash function and MAC,MD5 ,SHA ,HMAC, CMAC , Digital signature and authentication protocols , DSS ,EI Gamal – Schnorr.

Module-4

Authentication applications: Kerberos & X.509 Authentication services Internet Firewalls for Trusted System: Roles of Firewalls , Firewall related terminology-,Types of Firewalls ,Firewall designs, Intrusion detection system , Virus and related threats, Countermeasures , Firewalls design principles ,Trusted systems, Practical implementation of cryptography and security.

Module-5

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cryptography and Network Security Principles And Practice	William Stallings	Pearson Education, Fourth Edition	2005
2	A Course in Number Theory and Cryptology	Neal Koblitz	Springer	1987
Reference Book(s):				

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1	Cryptography and Network Security	Behrouz A Forouzan, DebdeepMukhopadhyay	Mc-GrawHill, 3rd Edition	2015
2	Applied Cryptography and Network Security	Damien Vergnaud and Michel Abdalla	7th International, Conference, ACNS 2009, Paris, France, June 2-5, 2009, Proceedings	2009

(Group-2): Course Code 20SSE14 Service Oriented Architecture	
Exam Hours: 3 hours	**Exam Marks(Maximum):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

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Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Service–Oriented Architecture for Enterprise Applications	Shankar Kambhampaly	Wiley	2008
Reference Book(s):				
1	SOA using Java Web Services	Mark D. Hansen	Practice Hall	2007
2	SOA-Based Enterprise Integration	WaseemRoshen	Tata McGraw-HILL	2009

(Group-2): Course Code 20SSE243 Information Retrieval	
Exam Hours: 3 hours	**Exam Marks(Maximum):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

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User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting pints, 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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Modern Information Retrieval,	Ricardo BaezaYates, BerthierRibeiroN eto	Pearson	1999
Reference Book(s):				
1	Information Retrieval Algorithms and Heuristics	David A. Grossman, OphirFrieder	Springer, 2nd Edition	2004

(Group-2): Course Code 20SFC251 Data mining & Data warehousing	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
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

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

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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
Module-4
Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering.
Module-5
Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society.
Question paper pattern:
- The question paper will have ten questions.   - Each full question is for 20 marks.   - There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.   - Each full question with sub questions will cover the contents under a module.   - Students will have to answer 5 full questions, selecting one full question from each module. ∎
Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Data Mining Concepts and Techniques	Jiawei Han, MichelineKamber, Jian Pei	ELSEVIER, 3rd edition	2012
Reference Book(s):				
1	Data Warehousing and data mining OLAP	Alex and Stephen I smith	Tata MGH	2008

Group-2 Mobile Applications Development	
Course Code:20MCA263	Exam Hours:03
Module-1	
Introduction : Preliminary Considerations – Cost of Development – Importance of Mobile Strategies in the Business World – Effective use of Screen Real Estate – Understanding Mobile Applications: Understanding Mobile Applications Users – Understanding Mobile Information Design – Understanding Mobile Platforms – Using the Tools of Mobile Interface Design.	
Module-2	
Getting Started with Android Programming What is Android – Obtaining the required tools– Anatomy of an Android	

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Application – Components of Android Applications – Activities – Fragments – Utilizing the Action Bar
Module-3
Android UI Design and Location Based Services
Views and View Groups – Basic Views – Fragments – Displaying Maps – Getting Location Data – Publishing for Publishing – Deploying APK Files
Module-4
Android Messaging and Networking
SMS Messaging – Sending Email – Networking – Downloading Binary Data, Text files – Accessing Web Services – Performing Asynchronous Call – Creating your own services – Communicating between a service and an activity – Binding activities to services
Module-5
Feedback and Oscillator Circuits
iOS – Obtaining the tools and SDK – Components of XCODE – Architecture of iOS – Building Derby App in iOS – Other useful iOS things – Windows Phone: Getting the tools you need – Windows Phone 7 Project
Building Derby App in Windows Phone 7 – Distribution – Other useful Windows Phone Thing
Text books
1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition, 2012, ISBN: 978-1-118-20390-3   2. Wei-Meng Lee, "Beginning Android Application Development", Wiley 2011.
References
1. Reto Meier, " Professional Android 4 Application Development ", Wrox Publications 2012.

Group-2 Distributed Operating System	
Course Code:20MCA264	Exam Hours:03
Module-1	
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 ComputingEnvironment(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.	
Module-2	
Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling	

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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.
Module-3
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
Module-4
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.
Module-5
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.
Text books
1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.
References
1. Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013. 2. Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008 3. SunitaMahajan, Seema Shan, " Distributed Computing", Oxford University Press,2015

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(Group-3): Course Code : 20SCN242	
Course Title: Switching & Statistical Multiplexing in Telecommunication	
Exam Hours: 3 hours	**Exam Marks(Maximum):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, Two-stage, 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, Modelling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems	

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Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Telecommunication Switching Systems and Networks	ThiagarajanViswa na than	PHI	1992
2	Digital Telephony	John.C.Bellamy	John Wiley and Sons Inc	3rd Edition, 2002
Reference Book(s):				
1	Computer Networks	By Andrew S Tanenbaum	Pearson	2013

(Group-3): Course Code : 20SCN321 : Computer System Performance Analysis	
Exam Hours: 3 hours	**Exam Marks(Maximum):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. Workload Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. workload 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

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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 Centres, Hierarchical Decomposition, Limitations of Queuing Theory.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	The Art of Computer Systems Performance Analysis	Raj Jain	John Wiley and Sons	2013
Reference Book(s):				
1	Computer Systems Performance Evaluation and prediction	Paul J Fortier	Howard E Michel, Elsevier	2003
2	Probability and Statistics with Reliability	Queuing and Computer Science Applications	Trivedi K S, Wiley India	2nd Edition, ,2001

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(Group-3): Course Code : 20SFC243 : Information Network Policies in Industry			
Exam Hours: 3 hours			**Exam Marks(Maximum):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: - The question paper will have ten questions. - Each full question is for 20 marks. - There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. - Each full question with sub questions will cover the contents under a module. - Students will have to answer 5 full questions, selecting one full question from each module.■			
Textbook/Reference Books			
Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):			

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1	Writing Information Security Policies	Scott Barman	Sams Publishing	2002
2	Information Policies Procedures and Standards	Thomas.R.Peltier	CRC Press	2004
Reference Book(s):				
1	Information Security Fundamentals	Thomas R Peltier, Justin Peltier, John Backley	CRC Press	2005
2.	Information Security Management Handbook	Harold F. Tipton and Micki Krause	Auerbach publications	5th Edition, 2005

(Group- 3): Course Code : 20SCN332 Protocol Engineering	
Exam Hours: 3 hours	**Exam Marks(Maximum):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.	

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Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Communication Protocol Engineering	Venkataram&Manvi et. al.	PHI Learning Pvt. Ltd,	2004
Reference Book(s):				
1	Communication Protocol Engineering	MiroslavPopovic	CRC Press	2006
2	Protocol Engineering	Konig, Hartmut	Springer	2012

(Group-3): Course Code : 20SAM334 **:** Speech Processing	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications Digital speech for man machine communication by voice.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.

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- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Digital Processing of Speech Signals	Lawrence R. Rabiner, Ronald W. Schafer	Pearson	2003
Reference Book(s):				
1	Speech And Audio Signal Processing: Processing And Perception Of Speech And Music,	Ben Gold	WILEY INDIA	2011

(Group- 3):   Course Code : 20SSE12
Course Title : Advances in Software Testing

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

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.

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.

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 objectoriented testing, GUI testing, Dataflow testing for object-oriented software, Examples. **Class Testing:** Methods as units, Classes as units.

Module-4

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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.

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Software Testing	A Craftsman's Approach, Paul C. Jorgensen,	Auerbach Publications	3rd Edition, 2013
Reference Book(s):				
1	Foundations of Software Testing	Aditya P Mathur	Pearson	2008
2	Software Testing and Analysis – Process, Principles and Techniques	Mauro Pezze, Michal Young	John Wiley & Sons	2008

(Group-3): Course Code : 220SFC253 Enterprise Application Programming	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

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.

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Module-2
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.
Module-3
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.
Module-4
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.
Module-5
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.
Question paper pattern: • The question paper will have ten questions. • Each full question is for 20 marks. • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. • Students will have to answer 5 full questions, selecting one full question from each module.■
Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	JAVA SERVER PROGRAMMING JAVA EE6(J2EE 1.6)	Kogent learning solution	Dreamtech press	2014

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Reference Book(s):			
1	Java the complete Reference	Herbert Schildt, Mc Graw Hill	Oracle Press	2017

(Group- 3): Course Code : 20SCS244 : Pattern Recognition	
Exam Hours: 3 hours	Exam Marks(Maximum):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 Neighbour based classifiers & Bayes classifier: Nearest neighbour 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, Bayesian belief network

Module-4

Naive Bayes classifier, Bayesian 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, kmeans, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Pattern Recognition (An Introduction)	V Susheela Devi, M Narsimha Murthy	Universities Press	2011

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2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh,	PH	1996
Reference Book(s):				
1	Pattern Classification	Duda R. O., P.E. Hart, D.G. Stork	John Wiley and sons	2000

(Group-3): Course Code : 20SCS13 Advances in Data Base Management System	
Exam Hours: 3 hours	**Exam Marks(Maximum):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. **Object and Object-Relational Databases**: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.	
Module-2	
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. **Distributed Database Concepts:** Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases,Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems , Distributed Database Architectures, Distributed Catalogue Management.	
Module-3	
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. **Big Data Technologies Based on MapReduce and Hadoop:** What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion	
Module-4	
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases:Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases. **Introduction to Information Retrieval and Web Search**:Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval	
Module-5	

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Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools **Overview of Data Warehousing and OLAP:**Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	2013
2	Database Management Systems	Raghu Ramakrishnan and Johannes Gehrke	McGraw-Hill	3rd Edition, 2013.
Reference Book(s):				
1	Database System Concepts,	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	6th Edition, 2010

Group-3 20MCA 262 Artificial Intelligence	
Course Code:20MCA262	Exam Hours:03
Module-1	
INTRODUCTION TO Al AND PRODUCTION SYSTEMS Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.	
Module-2	
REPRESENTATION OF KNOWLEDGE Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.	
Module-3	

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KNOWLEDGE INFERENCE Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.
Module-4
PLANNING AND MACHINE LEARNING Basic plan generation systems – Strips -Advanced plan generation systems – K strips - Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.
Module-5
EXPERT SYSTEMS Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.
Text books
1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill-2008. (Units-I,II,VI & V) 2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).
Reference books
1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007. 2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007. 3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013. 4. http://nptel.ac.in

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Ph.D Coursework Courses under Group 4			
Sl.No	**Course Code**	**Course**	**Page**
1	20SFC254,	Machine Learning Techniques	2
2	20LNI324,	Wireless Sensor Networks	3
3	20LNI332,	Social Network Analysis	4
4	20SSE13,	Object Oriented Software Engineering	5
5	20SIS14,	Internet of Things and Applications	6
6	20SIS12,	Cloud Computing	7
7	20SSE23	Software Design Patterns	9
8	20SAM333	Multidisciplinary Design Optimization	10
9	20LNI252,	Software Agents	11

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(Group-4): Course Code : 20SFC254, 20SSE334, Machine Learning Techniques	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 LEARNINGL 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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Machine Learning	Tom M. Mitchell	McGraw-Hill Education	2013
Reference Book(s):				
1	Introduction to Machine Learning	EthemAlpaydin	PHI Learning Pvt. Ltd	2 nd Ed., 2013
2	The Elements of Statistical Learning	T. Hastie, R. Tibshirani, J. H.	Springer	1st edition, 2001

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(Group-4):   Course Code : 20LNI324,
: Wireless Sensor Networks

Exam Hours: 3 hours	Exam Marks(Maximum):100

Module-1

CHARACTERISTICS OF WSN Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Module-2

MEDIUM ACCESS CONTROL PROTOCOLS Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Module-3

ROUTING AND DATA GATHERING PROTOCOLS Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Module-4

EMBEDDED OPERATING SYSTEMS Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Module-5

APPLICATIONS OF WSN WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				

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1	Wireless Sensor Networks Technology, Protocols, and Applications	KazemSohraby, Daniel Mino	John Wiley & Sons	2007
2	Protocols and Architectures for Wireless Sensor Network	Holger Karl and Andreas Willig	John Wiley & Sons, Ltd	2005
Reference Book(s):				
1	A survey of routing protocols in wireless sensor networks	K. Akkaya and M. Younis	Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349	2012
2	TinyOS Programming	Philip Levis	Stanford University	2009
3	Wireless Sensor Network Designs	Anna Ha´c	John Wiley & Sons Ltd	2003

(Group-4): Course Code : 20LNI332, : Social Network Analysis	
Exam Hours: 3 hours	**Exam Marks(Maximum):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. 20082020/38 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, retweets.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each

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	module.■			
Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Networks, Crowds, and Markets: Reasoning About a Highly Connected World	David Easley and John Kleinberg	Cambridge University Press	2010
2	Statistical Analysis of Network Data with R	Eric Kolaczyk, Gabor Csardi	Springer	2014
3	Social Network Analysis. Methods and Applications	Stanley Wasserman and Katherine Faust	Cambridge University Press	1994
Reference Book(s):				
1	Social Networks and the Semantic Web	Peter Mika	Springer	2007

(Group-4): Course Code : 20SSE13, : Object Oriented Software Engineering	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 actives, 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 20082020/9 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

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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 actives, 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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Object-Oriented Software Engineering	Bernd Bruegge, Alan H Dutoit	Pearson Education	3 rd edition, 2014
2	Object oriented software engineering	David C. Kung	Tata McGraw Hill	2015
Reference Book(s):				
1	Object oriented software engineering	Stephan R. Schach	Tata McGraw Hill	2008
2	Applying UML and Patterns	Craig Larman	Pearson Education	3rd ed, 2005

(Group-4): Course Code : 20SIS14,	
: Internet of Things and Applications	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

What is The Internet of Things? Overview and Motivations, Examples of Apllications, 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 Apjplication Examples-Overview, Smart Metering/Advanced Metering InfrastructureHealth/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.

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 Low power WPAN, Zigbee IP(ZIP),IPSO

Module-3

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Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity: 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.

Module-4

Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications	Daniel Minoli	Wiley	2013
2	Internet of Things: A Hands-on Approach	ArshdeepBahga, Vijay Madisetti	Universities Press	2015
Reference Book(s):				
1	The Internet of Things	Michael Miller	Pearson	2015 First Edition
2	Designing Connected Products	Claire Rowland,Elizabeth Goodman et.al	O'Reilly	First Edition, 2015

(Group-4): Course Code : 20SIS12, : Cloud Computing	
Exam Hours: 3 hours	**Exam Marks(Maximum):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

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cloud Computing Theory and Practice	Dan C Marinescu	Elsevier(MK)	2013
Reference Book(s):				

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| 1 | RajkumarBuyya , James Broberg, Andrzej Goscinski | Computing Principles and Paradigms | Willey | 2014 |
| 2 | Cloud Computing Implementation, Management and Security | John W Rittinghouse, James F Ransome | CRC Press | 2013 |

(Group-4): **Course Code :** 20SSE23
Course Title : Software Design Patterns

Exam Hours: 3 hours	**Exam Marks(Maximum):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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Object-oriented analysis, design and implementation	Brahma Dathan, SarnathRammath	Universities Press	2013

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2	Design patterns	Erich Gamma, Richard Helan, Ralph Johman , John Vlissides	PEARSON	2013
Reference Book(s):				
1	Pattern Oriented Software Architecture Volume 1	Frank Bachmann, RegineMeunier	Hans Rohnert	1996
2	Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis	William J Brown et al	John Wiley	1998

(Group-4): Course Code : 20SAM333
Course Title : Multidisciplinary Design Optimization

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Basic Concepts: Optimal Design Problem Formulation, Solution Existence and Uniqueness, Functions of One Variable: Concepts and Newton's Method, Polynomial Fit and Golden Section Search

Module-2

Unconstrained Functions in N Variables: Zero-Order Methods, First-Order Methods, Scaling and Convergence, Conjugate Direction and Variable Metrics (DFP and BFGS), Newton's Method, Variable Scaling Issues, Constrained Functions in N Variables - Sequential Unconstrained Minimization Techniques: Exterior Penalty Methods, Interior and Extended Interior Penalty Methods,

Module-3

Variable Penalty Function, Comparison of Penalty Methods, Constraint Scaling, Augmented Lagrange Method (ALM) for Equality Constraints, ALM for Inequality Constraints and Generalized ALM ; Linear Programming: Simplex Method; Constrained Functions in N Variables - Direct Methods: Overview, Zero-Order Methods, Feasible Directions,

Module-4

Zoutendjik's Feasible Directions, Reduced Gradient, Sequential Quadratic Programming, Sequential Quadratic Programming , Global Optimization: Simulated Annealing, Nelder-Mead Simplex, Genetic Algorithm

Module-5

Multiobjective Optimization: Pareto Optimality, Global Function /Weighted Sum, EpsilonConstraint or Gaming Approach , Min-Max, Goal Attainment, Recent MDO Techniques: Approximations and Response Surface Methodology in MDO, problem decomposition strategies

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year

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Textbook(s):				
1	Multidiscipline Design Optimization (ISBN: 0-944956-04-1)	Vanderplaats, G. N	VR&D	2007
2	Introduction to Optimum Design (ISBN: 9780-12-800806-5)	Arora, J. S	Elsevier Academic Press, San Diego, CA, 2016	Fourth Edition, 2016
Reference Book(s):				
1	Multidisciplinary Design Optimization Supported by Knowledge Based Engineering	JaroslawSobieszczanski–Sobieski and Alan Morris	Jaroslaw Willey	2015
2	Advances in Collaborative Civil Aeronautical Multidisciplinary Design Optimization 233 (Progress in Astronautics and Aeronautics)	Marin D. Guenov, Ernst Kesseler	American Institute of Aeronautics and	2010

(Group-4): Course Code : 20LNI252, : Software Agents	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
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

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

Module-3

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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.

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.

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Software Agents,	Jeffrey M. Bradshaw	PHI(MIT Press)	2012
Reference Book(s):				
1	Developing Intelligent Agent Systems: A Practical Guide	Lin Padgham and Michael Winikoff	John Wiley & sons	2004
2	Agent-Based and Individual Based modelling: A Practical Introduction	Steven F. RailsBack and Volker Grimm	Princeton University Press	2012
3	Disappearing Cryptography – Information Hiding: Steganography & Watermarking,	Peter Wayner	Morgan Kaufmann Publishers	2002
4	Multimedia Secuirty, Watermarking, Steganography and Forensics	Frank Y. Shih	CRC Press	2012

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(Group-5): Course Code : 20SCS31,		
: Deep Learning		
Exam Hours: 3 hours		**Exam Marks(Maximum):100**

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, BackPropagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, SemiSupervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. **Applications:** Vision, NLP, Speech.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Deep Learning	Lan Good fellow and YoshuaBengio and Aaron Courville	MIT Press https://www. deeplearn ingbook.org/,	2016

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Reference Book(s):				
1	Neural Networks	Asystematic Introduction	Raúl Rojas	1996
2	Pattern Recognition and machine Learning	Chirstopher Bishop	Springer	2007

(Group-5):   Course Code : 20LNI331, : Wireless Networks & Mobile Computing

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Emerging Technologies: Wireless broadband (WiMAX), Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6. Wireless Networks : Global Systems for Mobile Communication (GSM): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Service Messages (SMS): Introduction to SMS, SMS Architecture, SMMT, SMMO, 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.

Module-2

Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices.

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

Module-4

Building Wireless Internet Applications: Thin client overview: 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.

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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each

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module.■			

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Mobile Computing, Technology, Applications and Service Creation	Ashok Talukder, RoopaYavagal,	Tata McGraw Hill	2nd Edition, 2010
2	Mobile and Wireless Design Essentials	Martyn Mallik	Wiley India	2003
Reference Book(s):				
1	Mobile Computing	Raj kamal	Oxford University	2007
2	Wireless Communications and Networks, 3G and Beyond	ItiSahaMisra	Tata McGraw Hill	2009

(Group-5):   Course Code : 20SCN334
Course Title : Web Mining

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

INTRODUCTION: Crawling and Indexing, Topic Directories, Clustering and Classification, Hyperlink Analysis, Resource Discovery and VerticalPortals, Structured vs. Unstructured DataMining. **INFRASTRUCTURE and WEB SEARCH** -- Crawling the web – HTML and HTTP Basics – Crawling 20082020 /41 Basics – Engineering Large ScaleCrawlers- Putting together a Crawler- Boolean Queries and the Inverted Index – RelevanceRanking – Similarity Search.

Module-2

INFORMATION RETRIEVAL: Information Retrieval and Text Mining - Keyword Search - NearestNeighbour 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

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 Neighbour Learners, Feature Selection.

Module-4

LEARNING II : SUPERVISED LEARNING – Bayesian Learners, Exploiting Hierarchy among Topics, Maximum Entropy Learners, Discriminative Classification, Hypertext Classification, **SEMI SUPERVISEDLEARNING**-- Expectation Maximization, Labelling Hypertext Graphs and Cotraining.

Module-5

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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 Modelling 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.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Text Mining: Predictive Methods for Analysing Unstructured Information	Sholom Weiss	Sholom Weiss	2005
2	Mining the Web: Discovery Knowledge from Hypertext Data	SoumenChakrabarti	Elsevier Science	2003
Reference Book(s):				
1	Handbook of Research on Text and Web Mining Technologies	Vol I & II, Min SongYi-fang Brrok Wu	Information Science Reference (IGI)	2009
2	Insight into Data Mining Theory and Practice	K.P.Soman, ShyamDiwakar, V.Ajay	Prentice Hall of India	2006
3	Web Mining Applications and Techniques	Anthony Scime	Idea Group Publishing	2005
4	DATA MINING - Introductory and Advanced Concepts	Margret H.Dunham	PearsonEducation	2003

(Group-5): Course Code : 20SAM324, **Course Title** : Software Defined Networks	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
Introduction, Centralized and Distributed Control and Data Planes, OpenFlow	
Module-2	
SDN Controllers, Network Programmability,	
Module-3	
Data Centre Concepts and Constructs, Network Function Virtualization	
Module-4	
Network Topology and Topological Information Abstraction, Building an SDN Framework	

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Module-5
Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions

Question paper pattern:
- The question paper will have ten questions.   - Each full question is for 20 marks.   - There will be 2full questions (with a maximum of four sub questions in one full question) from each module.   - Each full question with sub questions will cover the contents under a module.   - Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	SDN: Software Defined Networks	Ken Gray, Thomas D. Nadeau	O'Reilly	2013
Reference Book(s):				
1	Software Defined Networks	Paul Goransson Chuck Black Timothy Culver	Elsevier	2nd Edition 2016

(Group-5): Course Code : 20SCS332, : Robotics & Automation	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1
History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.

Module-2
Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and gripper

Module-3
Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis.   Robot actuation and feedback components Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems

Module-4

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Robot Sensors and Machine vision system Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics. Machine Vision System: Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

Module-5

Robots Technology of the future: Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. Artificial Intelligence: Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Automation, Production Systems and Computer Integrated	M.P. Groover	Pearson Education	2nd Edition, 2007
Reference Book(s):				
1	Robotics, control vision and Intelligence	Fu, Lee and Gonzalez	McGraw Hill International	2nd Edition, 2007
2	Robotic Engineering - An Integrated approach	Klafter, Chmielewski and	Prentice Hall of India	1stEdition, 2009

(Group-5): Course Code : 20LNI333,	
: Cloud Security	
Exam Hours: 3 hours	**Exam Marks(Maximum):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).

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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, Recommendations.
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:
• The question paper will have ten questions.   • Each full question is for 20 marks.   • There will be 2full questions (with a maximum of four sub questions in one full question) from each module.   • Each full question with sub questions will cover the contents under a module.   • Students will have to answer 5 full questions, selecting one full question from each module.∎
Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance	Tim Mather, Subra Kumaraswamy, Shahed Latif	Oreilly Media	2009
Reference Book(s):				
1	Securing the Cloud, Cloud Computer Security Techniques and Tactics	Vic (J.R.) Winkler	Syngress	2011

(Group-5): Course Code :20SAM243
Course Title : Probabilistic Graphical Models

Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
Intro and Refresher of Probabilities, Bayesian Networks (directed graphical models)	
Module-2	
Excurse Causality , Markov Networks (undirected graphical models) Factor graphs, Parameter Estimation	
Module-3	
Maximum-A-Posteriori Estimation, Bayesian Inference, EM, Inference and Learning in Hidden Markov Models Maximum Entropy Models, (Loopy) Belief Propagation	
Module-4	
Approximate Inference Conditional Random Field Learning , Energy Minimization, Structured Loss Functions	

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Module-5
Structured Support Vector Machines , Graph cuts

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Probabilistic graphical models – Principles and techniques	Daphne Koller and Nir Friedman	MIT press	2009
Reference Book(s):				
1	Introduction to Probability (Chapman & Hall/CRC Texts in Statistical Science)	Joseph K. Blitzstein, Jessica Hwang	Stanford University	2015
2	Probability: For the Enthusiastic Beginner	David J. Morin, Tata Mc-Graw Hill	CreateSpace Independent Publishing	2016

(Group-5): Course Code : 20SFC244, : Trust Management in E-Commerce	
Exam Hours: 3 hours	**Exam Marks(Maximum):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 ECommerce, Technology trust mechanism in E-Commerce, Perspectives of organizational, economic and political theories of inter-organizational trust, Conceptual model of inter-organizational trust in ECommerce 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.	

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Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Study Guide to E-Commerce Business Technology Society	Kenneth C. Laudon and Carol GuercioTrave	Pearson Education	2005
2	Inter-Organizational Trust for Business-to-Business Ecommerce	Pauline Ratnasingam	IRM Press	2005
Reference Book(s):				
1	Trusted Computing Platforms: TCPA Technology in Context	Siani Pearson, et al	Prentice Hall PTR	2002

(Group-5):   Course Code : 20SCS14
: Advanced Algorithms

Exam Hours: 3 hours	**Exam Marks(Maximum):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

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Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Introduction to Algorithms	T. H Cormen, C E Leiserson, R L Rivest and C Stein	PHI	3rd Edition, 2010
2	Algorithms	Kenneth A. Berman	Cengage Learning	2002
Reference Book(s):				
1	Fundamentals of Computer Algorithms	, Ellis Horowitz, SartajSahni, S.Rajasekharan	Universities press	2nd Edition, 2007

| **Group-5** |
Data Analytics using Python
Subject Code:**20MCA31**	Exam Hours:03

Module 1

Python Basic Concepts and Programming

Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings,

Parts of Python Programming Language, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type( ) Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

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Module 2

Python Collection Objects, Classes

Strings- Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists-Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files. Class Definition – Constructors – Inheritance – Overloading

Module 3

Data Pre-processing and Data Wrangling

Acquiring Data with Python: Loading from CSV files, Accessing SQL databases. Cleansing Data with Python: Stripping out extraneous information, Normalizing data AND Formatting data. Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.

Module 4
Web ScrapingAnd Numerical Analysis

Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors. NumPyEssentials:TheNumPy array, N-dimensional array operations and manipulations, Memory mapped files.

Module 5

Data Visualization with NumPy Arrays, Matplotlib, and Seaborn

Data Visualization: Matplotlib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches. Advanced data visualization with Seaborn.- Time series analysis with Pandas.

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Text Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition,Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised andupdated for Python 3.2, Network Theory Ltd., 2011.

3. Jake Vander plas, "Python Data Science Handbook: Essential tools for working with data", O'Reilly Publishers, I Edition.

References:

1.   Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010.

2.   Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 1st edition, 2009.

3.   Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005.

4.   Shai Vaingast, "Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd edition, 2014. 6. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012

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(Group-6):   Course Code :20SCS242,
Natural Language Processing & Text Mining

Exam Hours: 3 hours	Exam Marks(Maximum):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-FiniteState Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classesPart-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 Labelling, 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-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: 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 Text mining.

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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

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	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Natural Language Processing and Information Retrieval	TanveerSiddiqui, U.S. Tiwary	Oxford University Press	2008
2	Natural LanguageProcessingandText Mining	Anne Kao and Stephen R. Potee	Springer-Verlag London	2007
Reference Book(s):				
1	Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition	Daniel Jurafsky and James H Martin	Prentice Hall	2008 2nd Edition
2	Natural Language Understanding	James Allen	Benjamin/Cummingspublishing company	2nd edition, 1995
3	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T. Maybury	Kluwer academic Publishers	2000
4	Natural Language Processing with Python	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	2009
5	Foundations of Statistical Natural Language Processing	Christopher D.Manning and HinrichSchutze	MIT Press	1999

(Group-6): Course Code :20SFC323
Course Title : Mobile Device Forensics

Exam Hours: 3 hours	**Exam Marks(Maximum):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, Readonly 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	

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.∎

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Android Forensics Investigation, Analysis, and Mobile security for Google Android	Andrew Hoog, John McCash	Technical Editor, Elsevier	2011
Reference Book(s):				
1	Practical Mobile Forensics	SatishBommisetty, RohitTamma, Heather Mahalik	Packt Publishing	2014
2	Mobile Device Forensics	Andrew Martin	SANS Institute	2009

(Group-6): Course Code :20SIT244,
: Cyber Security &Cyber law

Exam Hours: 3 hours	**Exam Marks(Maximum):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

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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 20082020 / 23 Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives	SunitBelapure and Nina Godbole	Wiley India Pvt Ltd	2013

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2	Introduction to information security and cyber laws	Surya PrakashTripathi, RitendraGoyal, Praveen Kumar Shukla	Dreamtech Press	2015
Reference Book(s):				
1	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions	Thomas J. Mowbray	John Wiley & Sons	2013
2	Cyber Security Essentials	James Graham, Ryan Olson, Rick Howard	CRC Press	2010

(Group-6): Course Code :20SAM22, : Soft & Evolutionary Computing	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. **Introduction to classical sets and fuzzy sets:** Classical relations and fuzzy relations, Membership functions.	
Module-2	
Defuzzification, Fuzzy decision making, and applications.	
Module-3	
Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.	
Module-4	
Swarm Intelligence System: Introduction, background of SI, Ant colony system Working of ant colony optimization, ant colony for TSP. (Textbook 2)	
Module-5	
Unit commitment problem, particle Swarm Intelligence system Artificial bee colony system, Cuckoo search system. (Textbook 2)	

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Principles of Soft computing	Shivanandam, Deepa S. N	Wiley India	2011
2	Soft Computing with MATLAB Programming	N. P. Padhy S.P. Simon	Oxford	2015

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Reference Book(s):				
1	Neuro-fuzzy and soft computing	S.R. Jang, C.T. Sun, E. Mizutani	Phi (EEE edition)	2012
2	Soft Computing	SarojKaushikSunitaTiwari	McGrawHill	2018

(Group-6): Course Code :20LNI251, : Managing Big Data	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Meet Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce A Weather Dataset: Data Format, Analysing the Data with Unix Tools, Analysing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming

The Hadoop Distributed Filesystem The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Module-2

YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce,Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness

Hadoop I/O Data Integrity, Data Integrity in HDFS, LocalFileSystem, ChecksumFileSystem, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: SequenceFile

Module-3

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Developing a MapReduce Application The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, GenericOptionsParser, Tool, and ToolRunner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie   **How MapReduce Works** Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers

Module-4
MapReduce Types and Formats: MapReduce Types,Input Formats: Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output,   **Flume** Installing Flume, An Example,Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalogue.
Module-5
Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.   **Spark** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN
Question paper pattern: • The question paper will have ten questions.   • Each full question is for 20 marks.   • There will be 2full questions (with a maximum of four sub questions in one full question) from each module.   • Each full question with sub questions will cover the contents under a module.   • Students will have to answer 5 full questions, selecting one full question from each module.■
Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Hadoop: The Definitive Guide	Tom White	O'Reilley	Third Edition, 2012
Reference Book(s):				

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1	SPARK: The Definitive Guide	MateiZaharia and Bill Chambers	Oreilly	2018
2	Apache Flume: Distributed Log Collection for Hadoop	D'Souza and Steve Hoffman	Oreilly	2014

(Group-6):   Course Code :20SCS23,
: Blockchain Technology

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency?

Module-2

Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc.Bitcoinblockchain - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions

Module-3

Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).Bitcoin scripting language and their use

Module-4

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Some attacks on smart contracts

Module-5

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain.BeyondCryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms. Limitations of blockchain as a technology, and myths vs. reality of blockchain technology

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):			

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1	Blockchain Technology: Cryptocurrency and Applications	S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan	Oxford University Press	2019
2	Bitcoin and cryptocurrency technologies: a comprehensive introduction	Arvind Narayanan et. Al	Princeton University Press	2016

Reference Book(s):

1	Research perspectives and challenges for Bitcoin and cryptocurrency	Joseph Bonneau et al	SoK, IEEE Symposium on security and Privacy	2015
2	The bitcoin backbone protocol - analysis and applications	J.A.Garay et al	EUROCRYPT LNCS VOl 9057, (VOLII), pp	2015
3	Analysis of Blockchain protocol in Asynchronous networks	R.Pass et al	EUROCRYPT	2017
4	Fruitchain, a fair blockchain	R.Pass et al	PODC	2017
5	Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming	Josh Thompson	Create Space Independent Publishing Platform	2017

(Group-6): Course Code :20SFC252	
: Data Base Security	
Exam Hours: 3 hours	**Exam Marks(Maximum):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	

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Database Security and Auditing	Hassan A. Afyoun	CENGAGE Learning	2009
2	Database Security	Castano	Pearson Education	1995
Reference Book(s):				
1	Database security	Alfred Basta, Melissa Zgola	CENGAGE learning	2014

(Group-6): Course Code :20SCE253
Course Title : Decision Support System

Exam Hours: 3 hours	**Exam Marks(Maximum):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, 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. Modelling decision processes: Defining the problem and its structures, Decision models, Types of probability, Techniques for forecasting probabilities, Calibration and sensitivity, Chapter summary

Module-3

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Decision support system	George M.Marakas	PHI	2011
Reference Book(s):				
1	Decision Support Systems, 2ndEdn	Marakas	Pearson India	2015

(Group-6): Course Code :20SAM332,	
: Semantic Web and Social Networks	
Exam Hours: 3 hours	**Exam Marks(Maximum):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.

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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:
- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
Textbook(s):				
1	Thinking on the Web	Berners Lee, Godel and Turing	Wiley inter science	2008
2	Social Networks and the Semantic Web	Peter Mika	Springer	2007
Reference Book(s):				
1	Semantic Web and Semantic Web Services	Liyang Lu Chapman and Hall	CRC Publishers	2007
2	Semantic Web Technologies, Trends and Research in Ontology Based Systems	Paul Warren, Rudi Studer, John Davis	John Willet & Sons Ltd.	2006
3	Programming the Semantic Web	T.Segaran, C.Evans, J.Taylor	O'Reilly.	2009

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Group-6
Wireless Ad Hoc Networks

Course Code : 20MCA353	**Exam Hours : 03**

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 Challengesin Security Provisioning, Network Security Attacks, Key Management and Secure Touting 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.
Textbook
1. Ad-hoc Wireless Networks , C. Siva Ram Murthy & B. S. Manoj, Pearson Education, 2nd Edition, 2011
Reference Books
1. Ad-hoc Wireless Networks, Ozan K. Tonguz and John Wiley, 2007 ,Gianguigi Ferrari
2. Ad-hoc Wireless Networking. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du, Kluwer Academic Publishers, 2004
3. Ad-hoc Mobile Wireless Networks- Protocols and Systems, C.K. Toh, Pearson Education, 2002

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Group-6
Course title: NOSQL

Course Code:20MCA345	**Exam Hours:03**
Module-1	
Introduction to NoSQL Definition of NoSQL, History of NoSQL and Different NoSQL products. Exploring NoSQL Exploring Mongo DB Java/Ruby/Python, Interfacing and Interacting with NoSQL.	
Module-2	
NoSQL Basics :NoSQL Storage Architecture, CRUD operations with Mongo DB, Querying, Modifying and Managing. Data Storage in NoSQL: NoSQL Data Stores, Indexing and ordering datasets (MongoDB/CouchDB/Cassandra)	
Module-3	
Advanced NoSQL, NoSQL in Cloud, Parallel Processing with Map Reduce, Big Data with Hive.	
Module-4	
Working with NoSQL, Surveying Database Internals, Migrating from RDBMS to NoSQL, Web Frameworks and NoSQL, using MySQL as a NoSQL.	
Module-5	
Developing Web Application with NOSQL and NOSQL Administration Php and MongoDB, Python and MongoDB, Creating Blog Application with PHP.	
Textbooks	
1.Professional NOSQL Shashank Tiwari WROX Press	
References	
2. The Definitive Guide to Mongo DB, The NOSQL Database for cloud and Desktop Computing EelcoPlugge, Peter Membreyand Tim Hawkins APress	

Group-6
Digital Marketing

Course Code:20MCA343	**Exam Hours:03**
Module-1	
Introduction to Digital Marketing Evolution of Digital Marketing from traditional to modern era, Role of Internet; Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models.	
Module-2	
Internet Marketing and Digital Marketing Mix – Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix, Impact of digital channels on IMC; Search Engine Advertising: - Pay for Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation Display marketing: - Types of Display Ads - Buying Models - Programmable Digital Marketing - Analytical Tools - YouTube marketing.	

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Module-3
Social Media Marketing – Role of Influencer Marketing, Tools & Plan– Introduction to social media platforms, penetration & characteristics; Building a successful social media marketing strategy Facebook Marketing: - Business through Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools Linkedin Marketing: - Introduction and Importance of Linkedin Marketing, Framing Linkedin Strategy, Lead Generation through Linkedin, Content Strategy, Analytics and Targeting Twitter Marketing: - Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing, framing content strategy, Twitter Advertising Campaigns Instagram and Snapchat: - Digital Marketing Strategies through Instagram and Snapchat Mobile Marketing: - Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics Introduction to social media metrics
Module-4
Introduction to SEO, SEM, Web Analytics, Mobile Marketing, Trends in Digital Advertising– - Introduction and need for SEO, How to use internet & search engines; search engine and its working pattern, On-page and off-page optimization, SEO Tactics - Introduction to SEM Web Analytics: - Google Analytics & Google AdWords; data collection for web analytics, multichannel attribution, Universal analytics, Tracking code Trends in digital advertising
Module-5
Social Media Channels: Introduction, Key terms and concepts, Traditional media vs Social media. Social media channels: Social networking. Content creation, Bookmarking & aggregating and Location & social media. Tracking social media campaigns. Social media marketing: Rules of engagement. Advantages and challenges.
Social Media Strategy: Introduction, Key terms and concepts. Using social media to solve business challenges. Step-by-step guide to creating a social media strategy. Documents and processes. Dealing with opportunities and threats. Step-by-step guide for recovering from an online brand attack. Social media risks and challenges
Textbooks
1. Seema Gupta "Digital Marketing" Mc-Graw Hill 1st Edition – 2017
References
1. Ian Dodson "The Art of Digital Marketing" Wiley Latest Edition 2. Puneet Singh Bhatia "Fundamentals of Digital Marketing" Pearson 1st Edition – 2017 3. Prof. Nitin C. Kamat, Mr.Chinmay Nitin Kamat Digital Social Media Marketing Himalaya Publishing House Pvt. Ltd. Latest Edition