IK GUJRAL PUNJAB TECHNICAL UNIVERSITY

Scheme and Syllabus
of
Master of Technology
(Computer Science Engineering)

Batch 2015

By
Board of Studies CSE/IT/AMT

Semester –I

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTCS-101	Advanced Software Engineering	3	1	0	50	100	150	4
MTCS-102	Advanced Computer Architecture	3	1	0	50	100	150	4
MTCS-103	Information Security	3	1	0	50	100	150	4
MTCS-104	Advanced Database Systems	3	1	0	50	100	150	4
MTCS-105	Digital Image Processing	3	1	0	50	100	150	4
	Total	15	5	0	250	500	750	20

Semester –II

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTRM-101	Research Methodology	3	1	0	50	100	150	4
MTCS-201	Advanced Data Structures	3	1	0	50	100	150	4
MTCS-202	Soft Computing	3	1	0	50	100	150	4
	Elective- I	3	1	0	50	100	150	4
	Elective- II	3	1	0	50	100	150	4
	Total	15	5	0	250	500	750	20

Semester –III

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
	Elective- III	3	1	0	50	100	150	4
	Elective- IV	3	1	0	50	100	150	4
MTCS-307	Seminar	-	-	2	50	0	50	2
MTCS-308	Project	-	-	8	100	50	150	8
	Total	6	2	10	250	250	500	18

Semester –IV

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
MTCS-401	Dissertation	-	-	20	-	-	-	20
	Total	-	-	20	-	-	-	20

Elective	Subject	
	MTCS-203	Software Metrics
Elective 1	MTCS-204	Natural Language Processing
	MTCS-205	Advanced Operating System

Elective	Subject	
	MTCS-206	Cloud Computing
Elective II	MTCS-207	Data Warehousing & Data Mining
	MTCS-208	Service Oriented Architecture

Elective	Subject	
	MTCS-301	Component Based development
Elective III	MTCS-302	Big data analysis
	MTCS-303	Optimization Techniques

Elective	Subject	
	MTCS-304	Agile software development
Elective IV	MTCS-305	Information Retrieval
	MTCS-306	Advanced AI

1st Semester

MTCS-101 Advanced Software Engineering

Section- A

Software Project Management: Software Project Planning and its characteristics, Types of metrics, Effort Estimation- FP, LOC, FP vs. LOC, Schedule & Cost Estimation Models- Activity Networks-PERT/CPM, COCOMO-I, COCOMO-II, Risk Assessment- Probability Matrix, Risk Management. Agile Methodology- Scrum and XP.

Formal Methods: Basic concepts, mathematical preliminaries, Applying mathematical notions for formal specification, Formal specification languages, using Z to represent an example software component, the ten commandments Of formal methods, Formal methods- the road ahead.

Section- B

Component-Based Software Engineering: CBSE process, Domain engineering, Component-based development, Classifying and retrieving components and economics of CBSE.

Client/Server Software Engineering: Structure of client/server systems, Software engineering for Client/Server systems, Analysis modeling issues, Design for Client/Server systems, Testing issues

Section- C

Web Engineering: Attributes Of web-based applications, the WebE process, a framework for WebE. Formulating, Analysing web-based systems, design and testing for web-based applications, Management issues.

Reengineering: Business process reengineering, Software reengineering, Reverse reengineering, Restructuring, Forward reengineering, economics of reengineering.

Section- D

Software Quality: CASE tools, metrics, Standards, Certification and Assessment. TQM, Bootstrap methodology, The SPICE project, ISO-IEC 15504, Six Sigma Concept for Software Quality.

Computer-Aided Software Engineering: Building Blocks for CASE, taxonomy Of CASE tools, integrated CASE environments, Integration architecture, and CASE repository

Recommended Books
1. Software Engineering a Practitioners Approach, Roger S. Pressman, McGraw-Hill 8thEdition, 2014
2. Formal Specification and Documentation testing - A Case Study Approach, J.Bowan , International Thomson Computer Press, 2003
3. Software Engineering for Embedded Systems: Methods, Practical and Applications, Robert Oshana, Mark Kraeling, Newnes Publisher, 2013
4. Software engineering an engineering approach, James S. Peters, WitoldPedrycz, Wiley India, 2011.
5. Software Engineering Principles and Practice, Hans Van Vliet, Yded, 2015

MTCS-102 ADVANCED COMPUTER ARCHITECTURE

Section-A
Fundamentals of Processors: Instruction set architecture; single cycle processors, hardwired and micro-coded FSM processors; pipelined processors, multi-core processors; resolving structural, data, control and name hazards; analyzing processor performance.

Section-B

Fundamentals of Memories: memory technology; direct-mapped, associative cache; write- through and write-back caches; single-cycle, FSM, pipe-lined cache; Analyzing memory performance.

Section-C

Advanced Processors: Superscalar execution, out-of-order execution, register renaming, memory disambiguation, dynamic instruction scheduling, branch prediction, speculative execution; multi-threaded, VLIW and SIMD processors.

Section-D

Advanced Memories: non-blocking cache memories; memory protection, translation and virtualization; memory synchronization, consistency and coherence.

Recommended Books:

1. **Computer Architecture: A Quantitative Approach, by J.L Hennessy and D.A Patterson.**
2. **Digital Design and Computer Architecture, by D.M Harris and S.L Harris.**

MTCS-103 INFORMATION SECURITY

Section -A
Overview: Computer Security Concepts, Requirements, Architecture, Trends, Strategy,
Edge/boundary Security: Firewalls, Intrusion Detection, Intrusion Prevention systems, Honeypots.

Section- B
User Authentication: Password, Password-based authentication, token basedauthentication,
Biometric authentication, Remote User authentication. Access Control: Principles, Access Rights,
Discretionary Access Control, Unix File Access Control, Role Based Access Control Internet
Authentication Applications: Kerberos, X.509, PKI, Federated Identity Management.

Section-C
Cryptographic Tools: Confidentiality with symmetric encryption, Message Authentication & Hash
Functions, Digital Signatures, Random and pseudorandom Numbers. Symmetric Encryption and
Message Confidentiality: DES, AES, Stream Ciphers, Cipher Block Modes of Operation, Key
Distribution.
Internet Security Protocols: SSL, TLS, IPSEC, S/ MIME.

Section- D
Database Security: The Need for Database Security, Database Management Systems, Relational
Databases, Database Access Control, Inference, Statistical Databases, Database Encryption, Cloud
Security

Malicious Software: Types of Malicious Software (Malware), Propagation–Infected Content–
Viruses, Propagation–Vulnerability Exploit–Worms, Propagation–Social Engineering–SPAM E-
mail, Trojans, Payload–System Corruption, Payload–Attack Agent–Zombie, Bots, Payload–
Information Theft–Keyloggers, Phishing, Spyware, Payload–Stealthing–Backdoors, Rootkits

Suggested Readings
1. Computer Security: Principles and Practice, William Stalling & Lawrie Brown, 2008,
Indian Edition 2010, Pearson
2. Chuck Easttom, "Computer Security Fundamentals" Pearson, 2011
3. M. Stamp, "Information Security: Principles and Practice," 2nd Edition, Wiley, ISBN:
0470626399, 2011.
4. M. E. Whitman and H. J. Mattord, "Principles of Information Security," 4th Edition, Course
Technology, ISBN: 1111138214, 2011.
5. M. Bishop, "Computer Security: Art and Science," Addison Wesley, ISBN: 0-201-44099-7,
2002.

MTCS-104 Advanced Database Systems

Section A
Data Base Analysis and Design Techniques: Review of   basic   Database Concepts, Database Design Methodologies. ER Modeling: Specialization, Generalization, Aggregation, Normalization Theory. Database Implementation using UML: Introduction to UML, Structure diagrams, behavioral diagrams, object oriented analysis, class diagram.

Advanced Transaction Processing and Concurrency Control:
Transaction Concepts, Concurrency Control: Locking Methods, Timestamping Methods, Optimistic Methods for Concurrency Control, Concurrency Control in Distributed Systems.

Section B
Query Compiler: Introduction, parsing, generating logical query plan from parse tree.

Query Processing: Physical-Query-plan Operators. Operations: selection, sorting, join, project, set.

Query Evaluation: Introduction, Approaches to QE, Transformation of relational expressions in Query optimization, heuristic optimization, cost estimation for various operations, transformation rule.

Section C
Distributed Database
Centralized DBMS and Distributed DBMS, functions and architecture of a DDBMS, Distributed Data Storage, Transparency issues in DDBMS, Query Processing DDBMS, Distributed transaction Management and Protocols, Distributed Concurrency Control and Deadlock Management.

Object Oriented Database
Limitations of RDBMS, Need of Complex Datatype, Data Definition, ODBMS Fundamentals, issues in OODBMS, Object-oriented database design.Comparison of ORDBMS and OODBMS.

Section D
Emerging Database Models, Technologies and Applications
Multimedia database-Emergence, difference from other data types, structure, deductive databases, GIS and spatial databases, Knowledge database, Information Visualization, Wireless Networks and databases, Personal database, Digital libraries, web databases, case studies.

References
1. Advanced database management system by RiniChkrabarti and ShibhadraDasgupta, Dreamtech.
2. Distributed Databases by Ozsu and Valduriez ,Pearson Education.
3. Fundamentals of Database Systems by RamezElmasri, ShamkantNavathe, Pearson Education
4. Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Tata McGraw-Hill.

MTCS-105 DIGITAL IMAGE PROCESSING

Section-A
Introduction: Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System.
Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.

Section-B
Image Transforms: Introduction to the Fourier Transform, The Discrete Fourier Transform, 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT- FFT – DCT - Hadamard Transform - Haar Transform - Slant Transform - KL Transform -Properties and Examples.

Image Enhancement : Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Background, Smoothing Filters, Sharpening Filters, Lowpass Filtering, Highpass Filtering, Generation of Spatial Masks from Frequency Domain Specifications.

Section-C
Image Restoration: Degradations Model - Definitions, Degradation Model for Continuous Functions, Diagonalization of Circulant and Block-Circulant Matrices, Effects of Diagonalization on the Degradation Model, Algebraic Approach to Restoration, Unconstrained Restoration, Constrained Restoration, Inverse Filtering – Formulation, Removal of Blur Caused by Uniform Linear Motion, Restoration in the Spatial Domain, Geometric Transformation.

Image Compression: Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria. Image Compression Models,Loss Less- Variable-Length, Huffman, Arithmetic Coding - Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding.

Section-D
Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation And Segmentation, Morphology-Dilation, Erosion, Opening And Closing. Hit And Miss Algorithms Feature Analysis

Color and multispectral Image processing: Color Image-Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models.Multispectral Image Analysis –
Color Image Processing Three Dimensional Image Processing-Computerized Axial Tomography-Stereometry-Stereoscopic Image Display-Shaded Surface Display.

Text Book:
1. Rafael. C. Gonzalez & Richard E.Woods.- Digital Image Processing, 2/e Pearson Education, New Delhi - 2006
Reference Books:
1. W.K.Pratt.-Digital Image Processing ,3/e Edn., John Wiley & sons, Inc. 2006
2.M. Sonka et.al Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007.
3. Digital Image Processing, Kenneth R Castleman, Pearson Education, 1995.
4. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009.
5. Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India, 1989.

2nd Semester

MTRM-101 Research Methodology

METHODS OF RESEARCH:
Nature and Objectives of research; historic al, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal.

INTRODUCTION TO STATISTICAL ANALYSIS:
Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis. Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution. Basic ideas of testing of hypotheses; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique.

DESIGN OF EXPERIMENTS:
Basic principles, study of completely randomized and randomized block designs. Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography. Use of common softwares like SPSS, Mini Tab and/or Mat Lab. For statistical analysis.

BOOKS RECOMMENDED:

1. G. C. Ramamurthy, Research Methodology, Dreamtech Press,
2. Borth Way ne C., The Craft of Research , Chicago Guides to Writing Edition and Publishing.
3. Johnson R.A., Probability and Statistics , PHI, New Delhi.
4. Meyer P.L., Introduction to Probability and Statistical, Applications , Oxford, IBH.
5. Hogg, R.V. and Craig A.T., Introduction to Mathematical Statistics , MacMillan.
6. Goon, A.M., Gupta, M.K. and Dasgupta, Fundamentals of Statistics , Vol. I: World Press.
7. Gupta, S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics , Sultan Chand and Sons.

MTCS-201 ADVANCED DATA STRUCTURE

Algorithms Complexity and Analysis: Probabilistic Analysis, Amortized Analysis, Competitive Analysis,Internal and External Sorting algorithms: Quick Sort, Heap Sort, Merge Sort, Counting Sort, Bin Sort, Multi-way merge sort, Polyphase sorting, Search: Hashing.

Advanced Data Structures: AVL Trees, Red-Black Trees, Splay Trees, B-trees, Fibonacci heaps, DataStructures for Disjoint Sets, Augmented Data Structures.

Graphs & Algorithms: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, HamiltonianPaths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning, , Depth- and breadth-first traversals, Minimum Spanning Tree: Prim's and Kruskal's algorithms, Shortest-path Algorithms: Dijkstra's and Floyd's algorithm, Topological sort, Max flow: Ford-Fulkerson algorithm, max flow – min cut.

String Matching Algorithms: Suffix arrays, Suffix trees, Rabin-Karp, Knuth-Morris-Pratt, Boyer-Moore algorithm.

Approximation algorithms: Need of approximation algorithms: Introduction to P, NP, NP-Hard and NP-Complete; Deterministic, non-Deterministic Polynomial time algorithms; Knapsack, TSP, Set Cover, Open Problems.

Randomized Algorithms: Introduction, Type of Randomized Algorithms, Quick Sort, Min- Cut, 2-SAT; Game Theoretic Techniques, Random Walks.

Recommended Books:

1. **Thomas Coremen, "Introduction to Algorithms", Third edition, Prentice Hall of India (2009).**
2. **Kleinberg J., Tardos E., "Algorithm Design", 1st Edition, Pearson, 2012.**
3. **Motwani R., Raghavan P., "Randomized Algorithms", Cambridge University Press, 1995.**
4. **Vazirani, Vijay V., "Approximation Algorithms", Springer, 2001.**

MTCS-202 Soft Computing

Soft Computing: An introduction. Artificial Neural Network: An introduction, Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, Back Propagation Network and other networks, Associative memory networks, Unsupervised Learning Networks.

Fuzzy Logic: Introduction to Fuzzy logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Membership functions, Defuzzification, Fuzzy Arithmetic and Fuzzy measures, Fuzzy Rule base and approximate reasoning, Fuzzy decision making

Genetic Algorithm: An introduction, Traditional Optimization and Search Techniques, GA and Search Space, General GA, Operators in GA, Stopping Condition and GA flow, Constraints in GA, Classification of GA, Genetic Programming.

Hybrid Soft Computing Techniques: An Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid systems, Genetic fuzzy Hybrid and fuzzy genetic hybrid systems,

References:
1. Principals of Soft Computing by Sivanandam and S. N. Deepa, Wiley Publication.
2. NEURAL NETWORKS, FUZZY LOGIC AND GENETIC ALGORITHM: SYNTHESIS AND APPLICATIONS By S. RAJASEKARAN, G. A. VIJAYALAKSHMI, PHI.
3. Introduction to Soft Computing By Samir Roy and Udit Chakraborty, Pearson.

MTCS-203 Software metrics

Basics of measurement: Measurement in everyday life, measurement in software engineering, scope of software metrics, representational theory of measurement, measurement and models, measurement scales, meaningfulness in measurement, goal-based framework for software measurement, classifying software measures, determining what to measure, software measurement validation, empirical investigation, types of investigation, planning and conducting investigations.

Software-metrics data collection and analysis: What is good data, how to define the data, how to collect the data, how to store and extract data, analyzing software-measurement data, frequency distributions, various statistical techniques.

Measuring internal product attributes: Measuring size, aspects of software size, length, functionality and complexity, measuring structure, types of structural measures, control-flow structure, modularity and information flow attributes, data structures.

Measuring external product attributes: Modeling software quality, measuring aspects of software quality, software reliability, basics of software reliability, software reliability problem, parametric reliability growth models, predictive accuracy, recalibration of software-reliability growth predictions, importance of operational environment, wider aspects of software reliability.

Metrics for object-oriented systems: Intent and characteristics of object-oriented metrics, various object-oriented metric suites LK suite, CK suite and MOOD metrics.

Dynamic Metrics: Runtime Software Metrics, Extent of Class Usage, Dynamic Coupling, Dynamic Cohesion, and Data Structure Metrics.

Metrics for component-based systems: The intent of component-based metrics, distinguishing characteristics of component-based metrics, various component-based metrics.

Resource measurement: Measuring productivity, teams, tools, and methods.

REFERENCES
1. Norman E-Fentor and Share Lawrence Pflieger." Software Metrics". International Thomson Computer Press, 1997.
2. Norman Fenton and James Bieman, "software metrics: a rigorous and practical approach, 3rded, CRC Press
3. Stephen H.Kan,"Metric and Models in software Quality Engineering", Addison QWesley 1995.
4. C. Ravindranath Pandian, software metrics: A guide to planning, analysis and application, CRC Press, 2003

MTCS-204 NATURAL LANGUAGE PROCESSING

Introduction: Natural Language Processing (NLP), Challenges of NLP, NLP Applications, Processing of Indian Languages.

Words and Word Forms: Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields, Scope Ambiguity and Attachment Ambiguity resolution.

Structures : Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

Machine Translation: Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation, UNL Based Machine Translation, Translation involving Indian Languages.

Meaning: Lexical Knowledge Networks, WorldNet Theory; Indian Language Word Nets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors.

Speech Recognition: Signal processing and analysis method, Articulation and acoustics, Phonology and phonetic transcription, Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

Recommended Books:
1.   Allen J., Natural Language understanding, Benjamin/Cunnings, (1987).
2.   Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
3.   Jensen K., Heidorn G.E., Richardson S.D., Natural Language   Processing: The PLNLP Approach, Springer (2013).
4.   Roach P., Phonetics, Oxford University Press (2012).
5.   Jurafsky, Dab and Martin, James, Speechand Language Processing, Second Edition, Prentice Hall, 2008.

MTCS-205 ADVANCED OPERATING SYSTEM

Distributed operating system: Architectures, Issues in Distributed operating systems, Limitations of Distributed Systems, Lamport's logical clock, Global states, Chandy-Lampert's global state recording algorithm,Basic concepts of Distributed Mutual Exclusion ,Lamport's Algorithm, Ricart-Agrawala Algorithm; Basic concepts of Distributed deadlock detection, Distributed File system, Architecture, Design issues, SUN Network File system Basic concepts of Distributed shared memory, Basic concepts of Distributed Scheduling, Load balancing, Load sharing.

Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory, Architecture, Algorithm, Protocols - Design Issues. Distributed Scheduling, Issues, Components, Algorithms.

Distributed OS Implementation: Models, Naming, Process migration, Remote Procedure Calls.

Failure Recovery and Fault Tolerance: Basic Concepts-Classification of Failures, Basic Approaches to Recovery; Recovery in Concurrent System; Synchronous and Asynchronous Checkpointing and Recovery; Check pointing in Distributed Database Systems; Fault Tolerance; Issues - Two-phase and Nonblocking Commit Protocols; Voting Protocols; Dynamic Voting Protocols

Multiprocessor System: Definition, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions & requirements; Design & Implementation Issue; Introduction to parallel programming; Multiprocessor Synchronization.

Real Time Operating systems: Fundamentals of real time operating systems,   real time multitasking, embedded   application,   preemptive   task   scheduling,   inter-task communication and synchronization.

Analytic Modeling: Introductions, Queuing Theory, Markov Process.

BOOKS RECOMMENDED

1.   OperatingSystemsConcepts &design-MilanMilenkovic,TMH
2.   OperatingSystem- H.M. Deitel,Pearsons.
3.   AdvancedConcepts inoperatingSystems-MukeshSinghal andNiranjanG.Shivaratri,TMH
4.   Mukesh Singhal and N. G. Shivaratri, "Advanced Concepts in Operating Systems",
McGraw- Hill, 2000
5.   Abraham Silberschatz, Peter B. Galvin, G. Gagne, "Operating System Concepts", Sixth
Addison n Wesley
Publishing Co., 2003.
6.   Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.

MTCS-206 CLOUD COMPUTING

Introduction: Cloud Computing definition, Cloud Types- Private, Public and Hybrid cloud. Cloud Services: Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Pros and Cons of PaaS Solutions. Infrastructure as a Service (IaaS)- Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Benefits and challenges of cloud computing.

Virtualization: Definition, Type of Virtualization, Benefits, Limitations, Virtualization and Cloud, Virtual Appliance.

Cloud based Data Storage: Introduction to MapReduce orimplified data processing on Large clusters, Design of data applications based on MapReduce in Apache Hadoop, Task Partitioning, Data partitioning, Data Synchronization, Distributed Filesystem, Data Replication

Cloud Services: Introduction, Contrast traditional software development and development for the cloud. Technologies and the processes required when deploying web services; deploying a web service from inside and outside a cloud architecture, advantages and disadvantages, Public vs Private cloud apps.

Management of Cloud Services: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics-Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization- application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google,Salesforce.com, Ubuntu and Red hat)

Open Source Cloud Computing and Testing: OpenStack, OpenNebula-underlying technologies, Cloud Monitoring-Ganglia; Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor. Software Testing in the Cloud - SMART-T- Migrating Testing to the Cloud, Hadoop Unit- Test Execution in the Cloud.

Advance Topics: Mobile Cloud Computing, Big-Data and Internet of Things (IoT): Definition of Big-Data, Structured and Unstructured Data, V's of Big-Data, Hadoop, Definition of IoT, Characteristics of IoT, Combining Big-Data, IoT and Cloud Computing.

Text Books and References:
1. Cloud Computing : A Practical Approach by Anthony T. Velte Toby J. Velte, Robert Elsenpeter, 2010 by The McGraw-Hill.
2. Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more. by Dr. Kris Jamsa.
3. Enterprise Cloud Computing Technology Architecture Applications by Gautam Shroff, Cambridge University Press; 1 edition, 2010.
4. Cloud Computing Strategies by Dimitris N. Chorafas, CRC Press; 1 edition,2010.
5. OpenStack Cloud computing Cookbook, Second Edition,by Kevin Jackson, Cody Bunch, Packt Publishing, 2013.
6. Software Testing in the Cloud Migration and Execution by Scott Tilley, Tauhida Parveen Springer, 2012.
7. OpenNebula 3 Cloud Computing by Giovanni Toraldo, , Packt Publishing, 2012.
8. Big Data for Dummies by Alan Nugent, Fern Halper, Judith Hurwitz and Marcia Kaufman, Wiley India, ISBN-13: 978-8-12-654328-1, April, 2013.

9. Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions by Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic and Marimuthu Palaniswami, Future Generation Computer Systems, vol. 29, no. 7, pp. 1645-1660, September, 2013.

MTCS-207 Data Warehousing and Data Mining

Data warehousing: Introduction, ETL, Data warehouses– design guidelines for data   warehouse implementation, Multidimensional Models; OLAP- introduction,   Characteristics, Architecture, Multidimensional view and data cube, Data cube operations, data cube computation.

Review of the Basic Data Analytic Methods using R: Introduction to R –look at the data, Analyzing and Exploring the Data, Statistics for Model Building and Evaluation.

Data mining: Introduction, association rules mining, Naive algorithm, Apriori algorithm, direct hashing and pruning (DHP), Dynamic Item set counting (DIC), Mining frequent pattern without candidate generation(FP, growth), performance evaluation of algorithms,

Classification: Introduction, decision tree, tree induction algorithms – split algorithm based on information theory, split algorithm based on Gini index; naïve Bayes method; estimating predictive accuracy of classification method;

Cluster analysis: Introduction, partitional methods, hierarchical methods, density based methods, dealing with large databases, cluster software;

Search engines: Characteristics of Search engines, Search Engine Functionality, Search Engine Architecture, Ranking of web pages, The search engine history, Enterprise Search, Enterprise Search Engine Software.

Web data mining: Web Terminology and Characteristics, Locality and Hierarchy in the web, Web Content Mining, Web Usage Mining, Web Structure Mining, Web mining Software.

Recommended Books:
1. Carlo Vercellis, Business Intelligence: Data mining and Optimization for Decision Making, WILEY.
2. Han J., Kamber M. and Pei J. , bData mining concepts and techniques, Morgan Kaufmann Publishers (2011) 3rd ed.
3. Pudi V., Krishana P.R., Data Mining, Oxford University press, (2009) 1st ed.
4. Adriaans P., Zantinge D., Data mining, Pearsoneducation press (1996), 1st ed.
5. Pooniah P. , Data Warehousing Fundamentals, Willey interscience Publication, (2001), 1st ed.

MTCS-208 Service Oriented Architecture

Introduction: Characteristics and Anatomy of SOA, Comparing SOA to client-server and distributed internet architectures, SOA component interrelation, Principles of service orientation. Major components of the architecture SOAP, XML, HTTP, Cookies, WSDL, XML schema, UDDI.

Introduction to Web services : Service descriptions , Messaging with SOAP ,Message exchange Patterns , Coordination ,Atomic Transactions , Business activities , Orchestration, Choreography ,Service layer abstraction , Application Service Layer , Business Service Layer , Orchestration Service Layer.

Analysis: Service oriented analysis ,Business-centric SOA , Deriving business services- service modeling ,Service Oriented Design , WSDL basics , SOAP basics , SOA composition guidelines , Entity-centric business service design ,Application service design , Task centric business service design

SOA platform basics: SOA support in J2EE ,Java API for XML-based web services (JAX-WS), Java architecture for XML binding (JAXB) ,Java API for XML Registries (JAXR) ,Java API for XML based RPC (JAX-RPC),Web Services Interoperability Technologies (WSIT) , SOA support in .NET , Common Language Runtime , ASP.NET web forms , ASP.NET web services , Web Services Enhancements (WSE)

Security: WS-BPEL , WS-Coordination , WS-Choreography, WS-Policy, WS-Security.

Recommended Books
1. Service-Oriented Architecture: Concepts, Technology, and Design, Thomas Erl, Pearson Education, 2005
2. Achieving Service-Oriented Architecture: Applying an Enterprise Architecture Approach, Rick Sweeney, 2010

Semester 3

MTCS- 301 Component Based Development

Section- A
Component Definition: Definition of Software Component and its Elements. Component Models and Component Services: Concepts and Principles, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization.

Section- B
Software Engineering Practices: The Practice of Software Engineering, From Subroutines to Subsystems: Component-Based Software Development.

The Design of Software Component Infrastructures: Software Components and the UML, Component Infrastructures: Placing Software Components in Context, Business Components, Components and Connectors: Catalysis Techniques for Defining Component Infrastructures, An Open Process for Component-Based Development, Designing Models of Modularity and Integration.

Section- C
The Management Of Component-Based Software Systems: Measurement and Metrics for Software Components, The Practical Reuse of Software Components, Selecting the Right COTS Software: Why Requirements are Important, Software Component Project Management Processes, The Trouble with Testing Software Components, configuration Management and Component Libraries, The Evolution, Maintenance and Management of Component-Based Systems.

Section-D
Component Technologies: Overview of the CORBA Component Model, Transactional COM+: Designing Scalable Applications, The Enterprise JavaBeans Component Model, Choosing Between COM+, EJB, and CCM, Software Agents as Next Generation Software Components.

Recommended Books
1. Component-Based Development: Principles and Planning for Business Systems, Addison Wilsey, 2010
2. Essential COM, Don Box, Dorling Kingsley, 2006.

MTCS- 302 Big Data Analytics

Section- A
An Overview of Big Data and Big Data Analytics. Understanding Hadoop Ecosystem (Hadoop Distributed File System, MapReduce, Hadoop YARN, HBase, Combining HBase and HDFS, Hive, Pig, Sqoop, ZooKeeper, Flume, Oozie). MapReduce Framework, Techniques to Optimize MapReduce Jobs, Role of HBase in Big Data Processing

Section- B
Developing Simple MapReduce Application, Points to Consider while Designing MapReduce. Controlling MapReduce Execution with InputFormat, Reading Data with Custom RecordReader, Organizing Output Data with OutputFormats, Customizing Data with RecordWriter, Optimizing MapReduce Execution with Combiner, Controlling Reducer Execution with Partitioners.

Section- C
YARN Architecture, Working of YARN, YARN Schedulers, Backward Compatibility withYARN, YARN Configurations, YARN Commands, YARN Containers. Introduction to NoSQL. Types of NoSQL Data Models, Schema-Less Databases, Materialized Views, Distribution Models.

Section- D
Analytical Approaches, Introducing to various Analytical Tools, Installing R, Handling Basic Expressions in R, Variables in R, Working with Vectors, Storing and Calculating Values in R, Creating and Using Objects, Interacting with Users, Handling Data in R Workspace, Executing Scripts, Reading Datasets and Exporting Data from R, Manipulating and Processing Data in R, Working with Functions and Packages in R, Performing Graphical Analysis in R, Techniques Used for Visual Data Representation, Types of Data Visualization

References:
1.   Big Data, Black Book by DT Editorial Services, Dreamtech Press.
2.   Big Data Computing and Communications edited by Yu Wang, Hui Xiong, Shlomo
        Argamon, XiangYang Li, JianZhong Li Springer
3.   Big Data Analytics Beyond Hadoop by Vijay Srinivas Agneeswaran, FT Press.

<center>**MTCS- 303 Optimization Techniques**</center>

SECTION-A
Introduction to Optimization Techniques, Origin & development of O.R., Nature & Characteristic, features of O.R., Models & Modeling in Operation Research.
Methodology of O.R. Linear Programming - Mathematical Model, Assumptions of Linear Programming, Graphical Method, Principles of Simplex method and its Applications, Two Phase & Big M- method, Revised simplex method , Duality, Dual simplex method- Primal Dual Relationship and sensitivity analysis.

SECTION-B
Linear Programming: Mathematical formation of linear programming problem, Special types of linear programming problems -Transportation and assignment problems, Unbalanced Assignment problems, Crew based assignment problems, Test for Optimality, Degeneracy in Transportation Problems, Unbalanced Transportation Problems.

SECTION-C
Definition of Probability, Sample Space, Algebra of Events, Addition and multiplication law of probability, Conditional Probability. Dynamic Programming-Features and applications of dynamic programming.

SECTION-D
Decision Theory, Integer Programming, Gomory Method and Branch & Bound Method.

References:
1. Kapoor, V.K.: Operation Research, Sultan Chand & Co., New Delhi.
2. Manmohan Gupta, P.K.: Operation Research, Sultan Chand & Co., New Delhi.
3. Pronsen, Richard: Theory and Problems of Operation Research, McGraw Hill, 1983.
4. Hiller, F.S. & Liberman, G.J., 1974: Introduction to Operations Research, 2nd Edn. Holden
5. Rao, S. S., 1978: Introduction to Optimization: Theory & Applications, Wiley Eastern.
6. Srinath, L.S.: Linear Programming, East-West, New Delhi.

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MTCS- 304 Agile Software Development

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Section- A
Agile Software Development: Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges
Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality

Section-B
Agile and Scrum Principles: Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values
Agile Product Management: Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

Section- C
Agile Requirements: User Stories, Backlog Management. Agile Architecture: Feature-Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools
Agile Testing: Agile Testing Techniques, Test-Driven Development, User Acceptance Test

Section- D
Agile Review: Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools
Scaling Agile for large projects: Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

Recommended Books
1. Agile Software Development, Principles, Patterns, and Practices (Alan Apt Series) Robert C. Martin (Author), 2011
2. Succeeding with Agile: Software Development Using Scrum, Pearson 2010.

MTCS- 305 Information Retrieval

Section- A
Introduction: Textanalysis, Types of text analysis, Information retrieval, IR system architecture: Text processing (Text format, Tokenization, stemming, lemmatization, Language modelling), Indexes and query matching.

Informational Retrieval: Query processing models. Probabilistic models (Binary independence model, Robertson/Spark Jones weighting formula, Two-Poisson model), Relevance feedback (Term selection, Pseudo relevance feedback); language models: Unigram, Bigram language models, Generating queries from documents, Language models and smoothing, Ranking with language models, KullbackLeibler divergence, Divergence from randomness, Passage retrieval and ranking.

Section- B
Management of Information Retrieval Systems: Knowledge management, Information management, Digital asset management, Network management, Search engine optimization, Records compliance and risk management, Version control, Information system failure.

Types of information retrieval systems: Web retrieval and mining, Semantic web, XML information retrieval, Recommender systems and expert locators, Knowledge management systems, Decision support systems, Geographic information system(GIS).

Section- C
Indexing: Inverted indices, Index components and Index life cycle, Interleaving Dictionary and Postings lists, Index construction, Query processing for ranked retrieval, Compression: General-purpose data compression, Symbol-wise data compression, Compressing posting lists, Compressing the dictionary.

Information categorization and filtering: Classification, Probabilistic classifiers, linear classifiers, Similarity-based classifiers, Multi category ranking and classification, learning to rank, Introduction to the clustering problem, Partitioning methods, Clustering versus classification, Reduced dimensionality/spectral methods.

Section- D
Sentiment Analysis: Introduction to sentiment analysis, Document-level sentiment analysis, Sentence-level sentiment analysis, Aspect-based sentiment analysis, Comparative sentiment analysis, baseline algorithm, Lexicons, Corpora , Tools of Sentiment analysis, Applications.

Recommended Books
1. Butcher S., Clarke C.L.A., Cormack G. Information Retrieval, MIT (1964), 2
Nd ed.
2. Bates M.J., Understanding Information Retrieval Systems, CRC press (2010), 3
rd ed.
3. Manning C.D., Raghavan P. and Schütze H. Introduction to Information Retrieval, Cambridge University Press (2008), 1st ed.

MTCS-306 Advanced AI

Section- A
Overview of AI problems, Intelligent behaviour, The Turing test, Rational versus non-rational reasoning, Problem characteristics: Fully versus partially observable, Single versus multi-agent, Deterministic versus stochastic, Static versus dynamic, Discrete versus continuous, Nature of agents: Autonomous versus semi-autonomous, Reflexive, Goal-based, and Utility-based.

Section-B
Basic Search Strategies: Problem spaces (states, goals and operators), Problem solving by search, Factored representation (factoring state into variables), Uninformed search (breadth-first, depth-first, depth-first with iterative deepening), Heuristics and informed search (hill-climbing, generic best-first, A*), Space and time efficiency of search, Constraint satisfaction (backtracking and local search methods).
Advanced Search: Constructing search trees, Dynamic search space, Combinatorial explosion of search space, Stochastic search: Simulated annealing, Genetic algorithms, Monte-Carlo tree search, Implementation of A* search, Beam search, Minimax Search, Alpha-beta pruning, Expectimax search (MDP-solving) and chance nodes.

Section-C
Knowledge Representation: Propositional and predicate logic, Resolution in predicate logic, Question answering, Theorem proving, Semantic networks, Frames and scripts, conceptual graphs, conceptual dependencies.
Reasoning under Uncertainty: Review of basic probability, Random variables and probability distributions: Axioms of probability, Probabilistic inference, Bayes' Rule, Conditional Independence, Knowledge representations using Bayesian Networks, Exact inference and its complexity, Randomized sampling (Monte Carlo) methods (e.g. Gibbs sampling), Markov Networks, Relational probability models, Hidden Markov Models, Decision Theory Preferences and utility functions, Maximizing expected utility.

Section-D
Agents: Definitions of agents, Agent architectures (e.g., reactive, layered, cognitive), Agent theory, Rationality, Game Theory Decision-theoretic agents, Markov decision processes (MDP), Software agents, Personal assistants, and Information access Collaborative agents, Information-gathering agents, Believable agents (synthetic characters, modelling emotions in agents), Learning agents, Multi-agent systems Collaborating agents, Agent teams, Competitive agents (e.g., auctions, voting), Swarm systems and Biologically inspired models.

Suggested readings
1.   Rich E., Artificial Intelligence, Tata McGraw Hills (2009) 3rd ed.
2.   George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009) 6th ed.
3.   Patterson D.W, Introduction to AI and Expert Systems, Mc GrawHill (1998), 1st ed.
4.   ShivaniGoel, Express Learning- Artificial Intelligence, Pearson Education Asia (2013), 1st ed.