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| **SCHEME OF EXAMINATION FOR M.TECH. (COMPUTER SCIENCE & ENGINEERING)** **w.e.f. Academic Session 2016-2017(CHOICE BASED CREDIT SYSTEM ( CBCS))** |
| **Paper Code** | **Nomenclature of Paper** | **Credit** | **Exam Time (hrs.)** | **External Marks** | **Internal Marks** | **Total Marks** |
| **Max** | **Pass** | **Max** | **Pass** |
| MT-CSE-16-11 | ADVANCES IN ALGORITHMS | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-12 | ADVANCED WEB TECHNOLOGIES | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-13 | DATA WAREHOUSING & DATA MINING | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-14 | ADVANCED COMPUTER ARCHITECTURE | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-15 | S/W LAB – I BASED ON MT-CSE-16-11 | 2.5 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-16 | S/W LAB – II BASED ON MT-CSE-16-12 | 2.5 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-17 | SEMINAR | 1 |  |  |  | 50 | 20 | 50 |
|  | **TOTAL** | **22** |  | **600** |  | **350** |  | **950** |
| MT-CSE-16-21 | OBJECT ORIENTED ANALYSIS & DESIGN USING UML | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-22 | DIGITAL IMAGE PROCESSING | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-23 | ELECTIVE - I | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-24 | ELECTIVE - II | 4 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-25 | S/W LAB – III BASED ON MT-CSE-16-21 | 2.5 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-26 | S/W LAB – IV BASED ON MT-CSE-16-22 | 2.5 | 3 | 100 | 40 | 50 | 20 | 150 |
| MT-CSE-16-27 | SEMINAR | 1 |  |  |  | 50 | 20 | 50 |
|  | **TOTAL** | **22** |  | **600** |  | **350** |  | **950** |
| **ELECTIVE PAPERS** |
| MT-CSE-16-23(i) SOFTWARE QUALITY MODELS & TESTINGMT-CSE-16-23(ii) HIGH PERFORMANCE NETWORKSMT-CSE-16-23(iii) ADVANCES IN DATABASES | MT-CSE-16-24(i) DISTRIBUTED SYSTEMSMT-CSE-16-24(ii) BIOMETRICS SYSTEM SECURITYMT-CSE-16-24(iii) SECURITY IN COMPUTING |

**Note 1:** Every student has to earn 2 credits by selecting an open elective paper from other department(s) of

Faculty of Sciences (Physical Sciences) of KUK during second semester (OE-201 to OE-209).

**Note 2:** Total Credits for the First Year will be 46 (22+22+2).

**Note 3:** Sessional Marks in each theory paper will be awarded by the concerned teacher on the basis of marks

obtained in one class test (of 30 Marks and 90 minutes’ duration) and evaluation of assignments (of 20 Marks).

**Note 4:** Sessional Marks in each practical paper will be awarded by the concerned teacher on the basis of

marks obtained in one practical exam (of 30 Marks and 90 minutes’ duration) and viva-voce (of 20 Marks).

**Note 4**: Size of Groups for all practicals should not be more than thirty students.

**MT-CSE-16-11 ADVANCES IN ALGORITHMS**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide in-depth coverage of advanced data structures and algorithm design techniques. It focuses on learning about analyzing and designing algorithms to solve a problem and learn to find the asymptotic efficiency of an algorithm.

**Learning Outcomes:**

At the end of this course students should be able to:

* Analyze worst-case running times of algorithms using asymptotic analysis.
* Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms

**UNIT – I**

Algorithms: Role of algorithms in computing, Asymptotic Notations, Standard notations and common functions.

Recurrence: The maximum-subarray problem, Strassen's algorithm for matrix multiplication substitution and recursion-tree method for solving recurrences, master method for solving recurrences, Proof of the master theorem, Probabilistic Analysis and Randomized Algorithms.

**UNIT – II**

Sorting: Bubble sort, Heap, Building and maintaining heap, Heapsort, Quicksort, Lower bounds for sorting, Counting sort, radix sort, bucket sort.

Advanced Data Structures: Splay Trees, Top-down splay trees, Red-black Trees, Deterministic skip lists, AA-Trees, Trie, Treaps, K-d Trees.

**UNIT – III**

Advanced Design and Analysis: Dynamic Programming: matrix-chain multiplication, Longest common subsequence, optimal binary search tree, Greedy algorithms: Huffman codes.

Graph Algorithms: Storage of graphs, traversing a graph, Topological sort, Minimum Spanning Trees, Shortest path problems: Single source and All-pairs shortest path, Maximum Flow networks, matching in bipartite graphs.

**UNIT – IV**

Miscellaneous Topics: Knapsack Problem and Memory functions, Approximate String Matching, Chinese remainder theorem, Integer factorization, naïve-string matching, Rabin-karp string matching, String matching with finite automata, Knuth-moris-pratt algorithm, finding convex hull, Polynomial time, verification and reducibility, NP-completeness and proofs.

**Text Books:**

1. Cormen, Thomos, Leiserson, “Introduction to Algorithms”, 3rd Ed., PHI Learning

2. Neapolitan R., Naimipour K., “Foundations of Algorithms”, 4th Ed., Jones and Bartlett Publishers.

**Reference Books:**

1. Anany Levitin, “Introduction to Design and Analysis of Algorithms”, 2nd Ed., Pearson Education.

2. Cooper A., “Computability Theory”, Chapman and Hall/ CRC Press.

3. Robert Sedgewick, “Algorithms in C: Fundamentals, Data Structures, Sorting, Searching, Parts 1-4”, 3rd

 Ed., Pearson Education India.

4. Steven Skiena, “The Algorithm Design Manual”, 2nd Ed., Springer India.

5. Reiter, Johnson, “Limits of Computation”, Chapman and Hall/ CRC Press.

**MT-CSE-16-12 ADVANCED WEB TECHNOLOGIES**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide fundamentals and advanced concepts of Web Services, JavaScript and PHP that lays foundations for the advanced studies in the area of web services.

**Learning Outcomes:**

At the end of this course students should be able to:

* Develop customized web based applications.
* Manage and optimize the web applications.
* Analyze the security of a web site and to make it more secure.

**UNIT – I**

Introduction: DNS caching and prefetching, CSS Expressions and performance, Buffering, Weblog; Search Engines: Searching techniques used by search engines, keywords, advertisements, Search Engine Optimization (SEO) for individual web pages: header entries, selection of URL; SEO for entire website: Hyperlinks and link structure, page rank of Google, robots.

Pitfalls in Optimization: optimization and testing, keyword density, duplicate contents, broken links, poor readability, navigation styles; tools for optimization: etracking, Google analytics.

**UNIT – II**

JavaScript: Introduction, Operators, Control Structures, looping constructs, functions, Array declaration and allocation, Handling Events Using JavaScript, data validation using regular expressions. Object oriented JavaScript, callbacks, closures, modules, AJAX, JQuery.

**UNIT - III**

PHP: Introduction, Data Types, Operators, Control Flow; Functions; Exception Handling, Storing and Retrieving Data, Arrays, String Manipulation and Regular Expressions, Object-Oriented PHP, Authentication with PHP, Interaction with File System and Server, Form processing, Handling Images, Session Management, Cookies, Debugging, Building CMS application.

**UNIT – IV**

Optimization: Optimizing images, Load balancers, Tuning MYSQL, query caching, query execution and optimization, traffic generation.

Security: Introduction, Handling user access and user input, Bypassing client-side controls, Authentication, Session hijacking, Attacks on data stores: SQL query log, SQL injections; Attacks on Users: XSS attacks; Cross-site Request Forgery (CXRF), DoS and DDoS attacks, DNS Hijacking.

**Text Books:**

1. Peter Smith, “Professional Website performance”, Wiley India Pvt. Ltd.

2. Deitel H.M., Deitel P.J., “Internet & World wide Web: How to program”, 4th Ed., Pearson Education.

**Reference Books:**

1. Kogent Learning, “Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX – Black Book”,

 Wiley India Pvt. Ltd.

2. Stuttard D., Pinto M., “The Web Application Hackers Handbook”, 2nd Ed., Wiley India Pvt. Ltd.

**MT-CSE-16-13 DATA WAREHOUSING & DATA MINING**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the fundamental concepts of data warehousing and data mining technology. It focuses on case studies to bring out practical aspects of building a data warehouse.

**Learning Outcomes:**

At the end of this course students should be able to:

* Develop step-by-step approach to designing and building a data warehouse.
* Solve different problems with the help of mining algorithms.
* Analyze Algorithms for sequential patterns.
* Extract patterns from time series data.
* Develop algorithms for Temporal Patterns.
* Extend the Graph mining algorithms to Web Mining

**UNIT – I**

Data Warehousing: Need for Data Warehousing, Paradigm Shift, Operational and Informational Data Stores, Data Warehouse Characteristics, Architecture for a Data Warehouse Data Warehouse Sourcing, Acquisition, Cleanup and Transformation tools, Metadata, Access Tools, Data Marts. OLAP Tools: Need for OLAP, Multidimensional Versus Multi relational OLAP, Categorization of OLAP tools, OLAP operations, Identifying Facts and Dimensions, Designing Fact Tables, Designing Dimension Tables.

Building a Data Warehouse: Data Warehouse Schemas. Steps for the Design and Construction of Data Warehouses. Business consideration, Design consideration, Technical consideration, Integrated Solutions.

**UNIT – II**

Data Mining: Introduction: Motivation, Knowledge Discovery Process, Kind of Data, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues.

Data Preparation: Preprocess, Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Primitives, Languages, and System Architectures. Concept Description and Data Generalization by Attribute-Oriented Induction.

**UNIT – III**

Mining Frequent patterns, Associations and Correlations: Market Basket Analysis, Frequent Itemsets, Closed Itemsets and Association Rules, Frequent Itemset Mining Methods, Pattern Evaluation Methods.

Decision Tree: Basics, building a Decision Tree, classifying by using Decision Trees, Building Multiple Decision Trees, Obtaining rules from Decision Trees.

**UNIT – IV**

Clustering: Clustering in Grouping, Agglomerative Hierarchical Clustering, K-means Clustering.

Multilayer Neural Nets: Neurodes, Modelling an AND Gate, Or Gate and XOR Gate. Commonly used Neunet Architecture.

Nearest Neighbour Classification: Performance of Nearest Neighbour classifier, Modification of Nearest Neighbour Classifier.

**Text Books:**

1. A. Berson, S.J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw-Hill.

2. J Han, M. Kamber and J. Pei, “Data Mining Concepts and Techniques”, 3rd Ed., Elsevier India.

**Reference Books:**

1. Rajjan Singhal, “Pattern Recognition Techniques and Applications”, Oxford University Press.

2. Zhao Y., Cen Y., “Data mining Applications with R”, Elsevier India.

**MT-CSE-16-14 ADVANCED COMPUTER ARCHITECTURE**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide in-depth coverage of current and emerging trends in Advanced Computer Architectures with emphasis on system design and performance. It focuses on instruction, data & thread level parallelisms and improvements in performance of memory hierarchy.

**Learning Outcomes**

At the end of this course students should be able to:

* Know the classes of computers, and new trends and developments in computer architecture
* Understand the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.
* Understand exploiting ILP using dynamic scheduling, multiple issue, and speculation.
* Understand data-level parallelism in vector, SIMD and GPU architectures.
* Understand multithreading by using ILP and supporting thread-level parallelism (TLP).
* Understand warehouse scale computers to exploit request-level & data level parallelism.
* Understand multiprocessor cache coherence using the directory based and snooping class of protocols.
* Understand the several advanced optimizations to achieve cache performance.
* Understand virtual memory and virtual machines.

**UNIT-I**

Instruction Level Parallelism (ILP): Concepts & Challenges, Data Dependences and Hazards, Control Dependences; Basic Compiler Techniques for Exposing ILP – Basic Pipeline Scheduling and Loop Unrolling, Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazardous with Dynamic Scheduling, Tomasulo’s Approach, Hardware Based Speculation; Exploiting ILP Using Multiple Issue and Static Scheduling – VLIW & Superscalar Processors, Advanced Techniques For Instruction Delivery and Speculation.

**UNIT-II**

Data Level Parallelism in Vector, SIMD & GPU Architectures: Vector Architecture – Working of Vector Processors, Vector Execution Time, Multiple Lanes, Vector Registers, Memory Banks, Stride, Gather Scatter; SIMD Instruction Set Extensions for Multimedia; Graphics Processing Units, Vector Architecture V/S GPUs, Multimedia SIMD V/S GPUs; Detecting and Enhancing Loop-Level Parallelism – Finding Dependences, Eliminating Dependent Computations.

Thread-Level Parallel Parallelism: Multiprocessor Architecture – Centralized Shared-Memory Architectures, Cache Coherence Problem, Schemes Enforcing Coherence, Snooping Coherence Protocol; Extensions to basic coherence protocol; Distributed Shared-Memory and Directory-Based Coherence

**UNIT-III**

Warehouse-Scale Computers (WSC) to Exploit Request-Level and Data-Level Parallelism: WSC V/S Servers, Programming Models and Workloads for WSC, Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of WSC.

Memory Hierarchy: Basics of Memory Hierarchy, Optimization of Cache Performance, Memory Technology & Optimizations, Virtual Memory – Fast Address Translation, Selecting Page Size, Protection of Virtual Memory

**UNIT-IV**

MIMD Architectures: Architectural Concepts of Distributed & Shared Memory MIMD Architectures (UMA, NUMA, COMA, CC-NUMA); Interconnection Networks – Direct Interconnection Networks (Linear Array, Ring, Star, 2D Mesh, Hyper Cubes), Switching Techniques; Dynamic Interconnection Networks (Shared Bus, Crossbar, Multistage Networks); Specifications of Top Three Super Computers of Top500 List.

**Text Books:**

1. Hennessy J.D., Patterson D.A., “Computer Architecture: A Quantitative Approach”, 5th Ed., MK, 2012.
2. Sima D., Fountain T., Kasuk P., “Advanced Computer Architectures - A Design Space Approach,” Pearson Education, 1997.

**Reference Books:**

1. Hesham El-Rewini, Mostafa Abd-El-Barr, “Advanced Computer Architecture and Parallel Processing”, Wiley India Pvt. Ltd.
2. Kai Hwang, “Advanced computer architecture – Parallelism, Scalability, Programmability”, Tata McGraw Hill, 2001.
3. Rajaraman V. & Murthy C.S.R., “Parallel Computer: Architecture & Programming”, PHI Learning.
4. David Culler, “Parallel Computer Architecture”, 1st Ed., Elsevier India.
5. Stallings W., “Computer Organization and Architecture”, 10th Ed., Pearson Education.

**MT-CSE-16–17 SEMInar**

**Maximum marks: 50 Time: 1/2 hours CREDITS: 1**

**Seminar**

Each student shall individually prepare and submit a seminar report within stipulated time. A panel consisting of two teachers (internal) should evaluate the seminar report and the presentation. Marks should be distributed considering report writing, presentation, technical content, depth of knowledge, brevity and references and their participation in seminar. The time allotted for presentation is 30 minutes.

**MT-CSE-16-21 OBJECT ORIENTED ANALYSIS & DESIGN USING UML**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the fundamental concepts of software prototyping, analysis and design process. It focuses on Unified Process Design and UML design technology.

**Learning Outcomes:**

At the end of this course students should be able to:

* Design various UML diagrams for any problem in hand.
* Apply various OOP solutions to any problem.

**UNIT – I**

UML: History of UML, Goals of UML, nature & purpose of models, UML views & diagrams – static, design, use case, state machine, activity, interaction deployment, model management, profile; relationships in UML – association, dependency, generalization, realization; UML extensibility mechanisms – constraints, stereotypes, tagged values.

Unified Process (UP): UP structure, phases of UP

**UNIT – II**

Requirements: Meta Model, Workflow, Functional and Non-functional Requirements; Requirement Attributes, Finding Requirements

Use Case Modeling: Finding Actors and Use Cases, Use Case Scenario – main flow, branching within a flow, repletion within a flow, modeling alternative flows; relationships among actors and use cases; use case diagrams

**UNIT – III**

Analysis: Meta Model, Workflows, Finding Analysis Classes – using noun/verb analysis, CRC analysis, using RUP stereotypes - entity, boundary and control; Modeling Classes – Association (role name, multiplicity, navigability, association classes, qualified association) dependencies (usage, abstraction, permission), class generalization, generalization sets, power types; Analysis Package – nested packages, dependencies, transitivity, package generalization, architectural analysis, finding analysis packages; Concepts of Patterns & Frameworks.

Use Case Realization – interaction diagram, sequence diagram; Activity Diagrams.

**UNIT – IV**

Design: Meta Model, Workflow, design classes – well-formed design classes, inheritance, templates, nested classes, design relationships, aggregation and composition, refining analysis relationships; interfaces and components – provided and required interfaces, interface realization v/s interface, components, finding interfaces, designing with interfaces; interaction diagram in design, modelling concurrency, active classes, concurrency in sequence diagram, concurrency in communication diagram; state machine - state machine diagrams; Implementation: Meta model, workflow, deployment diagram.

**Text Books:**

1. Jim Arlow, Ila Neustadt, “UML 2 and the Unified Process – Practical Object Oriented Analysis and Design”,

 2nd Ed., Pearson Education.

2. Bernd Bruegge, Allen H. Dutoit, “Object Oriented Software Engineering using UML”, 3rd Ed., Pearson

 Education.

**Reference Books:**

1. Rumbaugh J., Jacobson I., Booch G., “The Unifed Modeling Language Reference Manual”, 2nd Ed., Pearson

 Education.

2. Blaha M., Rumbaugh J., “Object-Oriented Modeling and Design with UML”, 2nd Ed., Pearson Education.

3. Timothy C. Lethbridge, Robert Laganiere, “Object Oriented Software Engineering”, Tata McGraw-Hill.

4. Booch G., Rumbaugh J., Jacobson I., “The Unified Modeling Language User Guide”, 2nd Ed., Pearson

 Education.

**MT-CSE-16-22 DIGITAL IMAGE PROCESSING**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the in-depth coverage of Digital Image Fundamentals and Processing Techniques. It focuses on transformations and filtering in Spatial Domain and Frequency Domain of images and other concepts like compression, segmentation and object recognition etc.

**Learning Outcomes:**

At the end of this course students should be able to:

* Classify Image representations
* Apply Image transformation methods
* Implement image processing algorithms
* Design of face detection and recognition algorithms

**UNIT – I**

Introduction to Digital Image Processing, Applications of digital image processing, Steps in digital image processing, Components of an Image Processing system, Image sampling and Quantization, Relationships between pixels.

Image Enhancement: Intensity transformations and spatial filtering, Point and Mask based techniques, Histogram processing, Fundamentals of spatial filtering, Smoothing and sharpening spatial filters.

**UNIT – II**

Filtering in frequency domain: Fourier Series and Transform, Discrete Fourier Transform, Frequency Domain Filtering Fundamentals, Homomorphic Filtering.

Color Image Processing: Color Fundamentals, Color characteristics, Color models, RGB, CYK, CMYK, HIS, YIQ models, Pseudo color image processing, full color image processing, color transformations, Smoothening and sharpening of images.

**UNIT – III**

Image Restoration: Model of Image Degradation/Restoration process, Noise models, Linear, Inverse filtering, Mean Square Error Restoration.

Image Compression: Fundamentals, Lossless and Lossy Compression, Compression Methods: Huffman Coding, Run-Length Coding, LZW Coding, Arithmetic Coding, Bit-Plane Coding, Predictive Coding, Transform Coding, Wavelet Coding, Compression standards.

**UNIT – IV**

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation.

Image Representation: Boundary Representation, Chain Codes, Polygonal Approximations, Signatures, Boundary Descriptors, Shape Numbers, Topological Descriptors, Texture, Watermarking, Blending of images.

**Text Book:**

1. Gonzalez R.C., Woods R.E., “Digital Image Processing”, 3rd Ed., Pearson Education.

2. Vipula Singh, “Digital Image Processing with MATLAB and LABVIEW”, 1st Ed., Elsevier India.

**Reference Books:**

1. Ganzalez R.C., “Digital Image Processing with MATLAB”, Tata McGraw Hill.

2. Sonka Milan, “Image Processing Analysis and Machine vision”, 4th Ed., Cengage Learning.

3. William K. Pratt, “Digital Image Processing”, 4th Ed., Wiley India Pvt. Ltd.

4. Chanda B., Majumder D. Dutta, “Digital Image Processing and Analysis”, 2nd Ed., PHI Learning.

5. Jain A.K., “Fundamental of Digital Image Processing”, PHI Learning.

6. Jayaraman S., Esakkirajan S., Veerakumar T., “Digital Image Processing”, 3rd Ed., Tata McGraw Hill.

7. Annadurai, “Digital Image Processing”, 1st Ed., Pearson Education.

**MT-CSE-16-23(I) SOFTWARE QUALITY MODELS & TESTING**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the in-depth coverage of software quality models and software testing strategies. It focuses on test case generation techniques and testing levels. It also focuses on testing different kinds of software.

**Learning Outcomes:**

At the end of this course students should be able to:

* Develop test cases for any problem.
* Pursue testing on any level of software design.

**UNIT – I**

Overview of SQM: Concepts of Software Quality, Quality Attributes, Software Quality Models: McCall, Boehm, ISO-9000, CMM.

Software testing principles: Need for testing, Psychology of testing, Testing economics, White box, Black box, Grey box testing, Software Development Life Cycle (SDLC) and Testing, Software Verification & Validation, Weyuker's adequacy axioms.

**UNIT – II**

Testing strategies: White box testing techniques: Control Flow based testing - Statement coverage, Branch Coverage, Path Coverage; Data flow based testing, Mutation testing, Automated code coverage analysis, Black box testing techniques: Boundary value analysis, Equivalence partitioning, Cause-effect graphing, Robustness testing, Levels of testing - Unit, Integration and System Testing; Acceptance testing: α, β, and γ testing.

**UNIT – III**

Configuration Management: Maintaining Product Integrity, Components, configuration items, change Management, Version Control, Configuration accounting, Reviews, Walkthrough, Inspection, and Configuration Audits.

Testing object oriented software: Challenges, Differences from testing non-Object Oriented Software, Class testing strategies, Class Modality, State-based Testing, Message Sequence Specification.

**UNIT – IV**

Testability and related issues: Design for Testability, Observability & Controllability, Design by Contract, Precondition, Post condition and Invariant, Regression Testing, Challenges, test optimization.

Miscellaneous topics: Stress Testing, Testing Client-server applications, testing compilers and language processors, testing web-enabled applications, Ad hoc testing: Buddy testing, pair testing, Exploratory testing, Agile and extreme testing.

**Text Books:**

1. Jorgensen P. C., “Software Testing - A Craftman's Approach”, 2nd Ed., CRC Press.

2. Glenford J. Myers, “The Art of Software Testing”, 3rd Ed., Wiley India Pvt. Ltd.

**Reference Books:**

1. Mathur P. Aditya, “Foundations of Software Testing”, 2nd Ed., Pearson Education.

2. Robert V. Binder, “Testing Object-Oriented Systems: Models Patterns and Tools”, Pearson Education.

3. Limaye G. M., “Software Testing – Principles, Techniques, and Tools”, Tata McGraw Hill.

4. Boris Beizer, “Black-Box Testing: Techniques for Functional Testing of Software and Systems”, 1st Ed.,

 Wiley India Pvt Ltd.

5. William E. Perry, “Effective Methods for Software Testing”, 3rd Ed., Wiley India Pvt Ltd.

**MT-CSE-16-23(Ii) HIGH PERFORMANCE NETWORKS**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to produce the students to the advanced concepts of computer networks, specially the Internet.

**Learning Outcomes:**

At the end of this course students should be able to:

* Understand Internet Architecture and its significant protocols
* Understand the Traffic Engineering in the Internet.
* Understand High Speed Networks viz. LANs and WANs
* Understand Wireless Networking Technologies
* Understand Routing Architecture in different Networks

**UNIT – I**

History of Networking and Internet; Need for Speed and Quality of Service; Advanced TCP/IP and ATM Networks; Internet Services; Internet Architecture; Backbone Networks; High Performance Networks; TCP Services; TCP format and connection management; SCTP; Encapsulation in IP; UDP Services, Format and Encapsulation in IP; IP Services; Header format and addressing; Fragmentation and reassembly; classless and subnet address extensions; subnetting and supernetting; CIDR; IPv6;

**UNIT – II**

Congestion Control and Quality of Service: Data traffic; Network performance; Effects of Congestion; Congestion Control; Congestion control in TCP and Frame Relay; Link-Level Flow and Error Control; TCP flow control;

Quality of Service(QoS): Flow Characteristics, Flow Classes; Techniques to improve QoS; Traffic Engineering; Integrated Services; Differentiated Services; QoS in Frame Relay and ATM; Protocols for QoS Support: Resource Reservation-RSVP; Multiprotocol Label Switching; Real-Time Transport Protocol;

**UNIT – III**

High Speed Networks: Frame Relay Networks; Asynchronous Transfer Mode (ATM); ATM protocol Architecture; ATM logical connections; ATM cells; ATM Service categories; ATM Adaptation Layer; ATM Switching and Signalling; Optical Networks: SONET networks; SONET architecture;

High-Speed LANs: Bridged and Switched Ethernet; Fast Ethernet; Gigabit Ethernet; Wireless LANs: IEEE 802.11, Bluetooth; Introduction to HIPERLAN; WIMAX; RFID, Sensor Networks; Vehicular Networks;

Cellular Telephony; Generations; Cellular Technologies in different generations; GSM, CDMA; Satellite Networks;

**UNIT – IV**

Internet Routing: Interior and Exterior Gateway Routing Protocols; RIP; OSPF; BGP; IDRP; Multicasting; IGMP; MOSPF; DVMRP; Routing in Ad Hoc Networks; AODV, DSR; Routing in ATM: Private Network-Network Interface; Mobile IP and Wireless Application Protocol;

Error and Control Messages: ICMP; Error reporting vs Error Correction; ICMP message format and Delivery; Types of messages; Address Resolution: ARP, BOOTP; DHCP; Network Management and SNMP;

**Text Books:**

1. Stallings W., “High-Speed Networks and Internets, Performance and Quality of Service”, 2nd Ed., Pearson

 Education.

2. B. Muthukumaran, “Introduction to High Performance Networks”, Vijay Nicole Imprints.

**Reference Books:**

1. James F. Kurose, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”,

 6th Ed., Pearson Education.

2. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Ed., Tata McGraw Hill.

3. Mahbub Hassan, Raj Jain, “High Performance TCP/IP Networking, Concepts, Issues, and Solutions”,

 Pearson Education.

4. William Stallings, “Wireless Communications & Networks”, 2nd Ed., Pearson Education.

**MT-CSE-16-23(Iii) ADVANCES IN DATABASES**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the fundamental concepts of advanced technologies in database. It also focuses on parallel & distributed database technology, web database, graph and no-sql databases.

**Learning Outcomes:**

At the end of this course students should be able to:

* Design distributed database for application development.
* Apply query optimization principles for optimizing query performance in centralized and distributed database systems
* Design distributed database schema using principles of fragmentation and allocation.
* Apply distributed transaction principles for handling transactions in distributed database applications.
* Apply distributed database administration principles for managing distributed database.
* Identify computing frameworks for Big Data analytics.

**UNIT – I**

Object Model: Overview of Object-Oriented concepts, Object identity, Object structure, Type constructors,

Encapsulation of operations, Methods, and Persistence, Type hierarchies and Inheritance, Complex objects. Query Processing and Optimization: Using Heuristics in Query Optimization, Semantic Query Optimization, Database Tuning in Relational Systems.

**UNIT – II**

Databases for Advance Applications: Architecture for parallel database; Distributed database concepts, Data fragmentation, Replication, and allocation techniques, Overview of Client-Server Architecture, Active Database Concept and Triggers, Temporal Databases Concepts, Spatial and Multimedia Databases, Deductive Databases, XML Schema, Documents and Databases

**UNIT – III**

Principles of Big Data: Ontologies and Semantics: Classifications, The Simplest of Ontologies, Ontologies, Classes with Multiple Parents, Choosing a Class Model. Data Integration and Software Interoperability Versioning and Compliance Issues, Stepwise Approach to Big Data Analysis, Failures and Legalities.

**UNIT – IV**

NoSQL Databases: Concepts, Schema, Schema Free, Two Phase Commit, Sharding & Share Nothing Architecture, Types of NoSQL Databases, CAP & BASE Theorems, Elastic Scalability, High Availability & Fault Tolerance, Tuneable Consistency, Writing and Reading Data, CRUD operations on documents with MongoDB.

**Text Books:**

1. Elmasri and Navathe, “Fundamentals of Database Systems”, 7th Ed., Pearson Education.

2. Jules J. Berman, “Principles of Big Data”, 1st Ed., Elsevier India.

**Reference Books:**

1. Date C.J., “An Introduction to Database Systems”, 8th Ed., Pearson Education.

2. Hector G.M., Ullman J.D., Widom J., “Database Systems: The Complete Book”, 2nd Ed., Pearson Education.

3. Silberschatz A., Korth H., Sudarshan S., “Database System Concepts”, 5th Ed., Tata McGraw Hill.

**MT-CSE-16-24(I) DISTRIBUTED SYSTEMS**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the in-depth coverage of distributed computing. It focuses on the problems and challenges in distributed environment and their solutions.

**Learning Outcomes:**

At the end of this course students should be able to:

* Identify models of distributed computing
* Analyze algorithms for coordination, communication, security and synchronization in distributed systems
* Classify distributed shared memory models
* Design and Implement distributed file systems
* Design distributed algorithms for deadlocks

**UNIT – I**

Introduction: Goals, Distribution Transparency, Types of Distributed Systems, Architectural styles, System architecture: Centralized, Decentralized, Hybrid; Architecture versus Middleware. Process: Process, Threads, Threads in distributed systems, virtualization, Clients, Servers, Server clusters, Code migration.

Communication and Naming: Types of communication, Remote procedure calls, message-oriented and stream oriented communication, multicast communication, names, identifiers, addresses, naming techniques, attribute based naming.

**UNIT – II**

Synchronization: clock synchronization, Global positioning system, logical clocks, vector clocks, mutual exclusion, election algorithm. Consistency and replication: Introduction to replication in distributed environment, data-centric and client -centric consistency models, replica management, consistency protocols.

**UNIT – III**

Fault Tolerance: Faults and failures, failure masking, process resilience, design issues, reliable client server communication, reliable group communication, distributed commit, recovery. Security: Security threats, policies and mechanisms, design issues, cryptography, secure channels, authentication, access control, firewall, denial of service, security management.

Distributed object-based systems: architecture, of distributed objects, processes and object servers, communication of distributed objects, naming and synchronization, security.

**UNIT – IV**

Distributed File systems: client server architecture, processes and communication, naming in NFS, File locking and sharing in Coda, File replication in distributed environment, Byzantine failures and other security aspects.

Distributed Web and Coordination Based Systems: Traditional web based systems, web server clusters, web proxy caching, replication and security in web based systems, traditional architecture of coordination models, content-based routing, static and dynamic replication.

**Text Books:**

1. Tanenbaum A.S., Steen M.V., “Distributed Systems: Principles and Paradigms”, 2nd Ed., PHI Learning.

2. Coulouris G., Dollimore J., Kindberg T., “Distributed Systems-Concepts and Design”, 5th Ed., Pearson

 Education.

**Reference Books:**

1. Attiya H., Welch J., “Distributed Computing: Fundamentals, Simulations and Advanced Topics”, 2nd Ed.,

 Wiley India Pvt. Ltd.

**MT-CSE-16-24(II) BIOMETRICS SYSTEM SECURITY**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide an overview of recent technology developments in the field of security, with particular emphasis on how the use of the technologies impacts on the lives of individuals.

**Learning Outcomes**

At the end of this course students should be able to:

* Understand methods and techniques with the help of examples of solving verification, identification, and synthesis problems for a variety of biometrics.
* Understand Biometrics such as fingerprint, face, eye, ear, palm, gait, voice, signature and others.
* Appreciate the hardware devices and their rapid development, as well as the variety of specific software developed for particular agencies (government, academia, banks, individuals etc.).

**UNIT-I**

Introduction to Biometrics, Biometrics technology evolution, Biometric Functionalities; Enrollment, Verification and Identification, Biometric characteristics, Different Biometric traits; Fingerprint, Face, Hand Geometry, Iris, Retina, Voice, Gait, Signature, Comparison of different biometrics, Biometric deformations, Biometric system errors; false match rate, false non-match rate, failure to capture and failure to enroll.

**UNIT-II**

Multibiometrics; Unimodal and Multimodal biometrics, Fusion in biometrics, Sources of biometric information for fusion, Levels of fusion; Sensor level fusion, Feature level fusion, Match score level fusion and Decision level fusion, Fusion methodologies, Issues in designing a multibiometric system, Score normalization, Advantages and disadvantages of multibiometrics, MUBI (Multimodal Biometrics Integration) software.

**Unit – III**

Biometrics Security; Biometric system challenges, Attacks on biometric system, Biometric cryptography, Liveness detection in biometrics, Cancelable biometrics, Biometric Sensors; Biometric sensor interoperability, Watermarking techniques; general watermarking process, framework of watermarking, application of watermarking, attacks on watermarking, watermarking algorithms.

**Unit – IV**

Fingerprint Recognition Technology; Fingerprint sensing and storage, fingerprint feature extraction, fingerprint matching, fingerprint classification and indexing, improving security and efficiency of biometric system, Applications of biometrics; Commercial sectors and Forensic sectors, Biometric databases. Fingerprint SDK. SFINGE (synthetic fingerprint generator), DET4J Tool for plotting DET and ROC Curves.

**Reference Books**

1. Handbook of Fingerprint Recognition, D. Maltoni, D. Maio, A.K. Jain, and S. Prabhakar, Springer 2003
2. Handbook of Multibiometrics (International Series on Biometrics), Arun A. Ross, Karthik Nandakumar, and Anil K. Jain, Hardcover - May, 2006
3. Handbook of Face Recognition, Editors: Stan Z. Li and Anil K. Jain Springer, New York, 2005
4. Biometrics: Concepts and Applications, Editors: G.R. Sinha and S.B. Patil, Wiley Publications.
5. Automatic Fingerprint Recognition Systems, N. Ratha and R. Bolle (Eds.), Springer, October 2003.
6. Guide to Biometrics, R. Bolle, J. Connell, S. Pankanti, N. Ratha and A. Senior, Springer, October 2003.

**MT-CSE-16-24(III) SECURITY IN COMPUTING**

**Maximum marks: 150 (External: 100, Internal: 50) Time: 3 hours Credits: 4**

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of objective type/short-answer type questions covering the entire syllabus. In addition to question no. 1, the examiner is required to set eight more questions selecting two from each unit. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit. All questions will carry equal marks.

**Objectives**:

The objective of this course is to provide the in-depth coverage of various security parameters and vulnerabilities. It also emphasizes on the proposed solutions.

**Learning Outcomes:**

At the end of this course students should be able to:

* Evaluate the risks and vulnerabilities in protocols/Standards.
* Apply Number Theory and Algebra required for designing cryptographic algorithms.
* Design symmetric key and asymmetric key encryption techniques.
* Design authentication, message integrity and authenticated encryption protocols
* Design and security analysis of systems including distributed storage and Electronic voting

**UNIT – I**

Computer Security Concept, Threats, Attacks and Assets, Security Functional Requirements, Security Architecture for Open System, Scope of Computer Security, Computer Security Trends and Strategy.

Cryptography: Terminology and Background, Substitution Ciphers, Transpositions, Cryptanalysis, Data Encryption Standard, DES & AES Algorithms and comparison, Public Key Encryption, Possible Attacks on RSA Malicious Software: Types of Malicious Software, Viruses, Virus countermeasures, Worms, Bots, Rootkits.

**UNIT – II**

Protection in General-Purpose Operating Systems: Security Methods of Operating Systems, Memory and Address Protection.

Designing Trusted Operating Systems: Security Policies, Models of Security, Designing of Trusted Operating System. Linux Security: Linux Security Model, Linux Vulnerabilities, Linux System Hardening, Application Security, Mandatory Access Control

**UNIT – III**

Database Security: Relational Database, Database Access Control, Inference, Statistical Databases, Database Encryption. Data Mining Security: Security Requirements, Reliability and Integrity, Sensitive data, Multilevel Databases, Proposal for Multilevel Security, Data Mining - Privacy and Sensitivity, Data Correctness and Integrity, Data Availability.

Trusted Computing: Concept of Trusted System, Trusted Computing and Trusted Platform Module, Common Criteria for Information Technology Security Evaluation.

**UNIT – IV**

Security in Networks: Threats in networks, Network security controls, Firewall and Intrusion Prevention Systems: Need, Characteristics, Types of Firewalls, Firewall Basing, Intrusion Prevention Systems. Intrusion Detection Systems.

Internet Security Protocols and Standards: Secure Socket Layer (SSL) and Transport Layer Security (TLS), IP4 and IP6 Security, Secure Email. Legal and Ethical Aspects: Cybercrime and Computer Crime, Intellectual Property, Copyrights, Patents, Trade Secrets, Privacy and Ethical Issues.

**Text Books:**

1. Pfleeger C. & Pfleeger S.L., “Security in Computing”, 4th Ed., Pearson Education

2. Stalling W., Brown L., “Computer Security Principles and Practice”, 3rd Ed., Pearson Education.

**Reference Books:**

1. Schneier B., “Applied Cryptography: Protocols, Algorithms and Source Code in C”, 2nd Ed., Wiley

India Pvt. Ltd.

**MT-CSE-16–27 SEMInar**

**Maximum marks: 50 Time: 1/2 hours CREDITS: 1**

**Seminar**

Each student shall individually prepare and submit a seminar report within stipulated time. A panel consisting of two teachers (internal) should evaluate the seminar report and the presentation. Marks should be distributed considering report writing, presentation, technical content, depth of knowledge, brevity and references and their participation in seminar. The time allotted for presentation is 30 minutes.