

MASTER OF COMPUTER APPLICATIONS

THIRD SEMESTER

CSE 611 A - DESIGN AND ANALYSIS OF ALGORITHMS (M)

3L, 1T

3 Hours, 80 Marks

Review of Algorithm and its specification, performance analysis and Randomized Algorithms. Random access machines (RAM), computational complexity of RAM program. Time and Space complexity, Asymptotic notations (Big-O, θ , Ω , and little-o & Ω). Complexity estimation using Substitution method, Recursion trees and Master Method.

Design of Efficient Algorithms: Divide and conquer: Binary Search, finding maximum and minimum, Merge Sort, Quick Sort, Matrix Multiplication, Convex Hull. Greedy methods: Knapsack problem, tree vertex splitting, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Optimal Reliability Allocation, Knapsack, Single Source Shortest Paths – Dijkstra's and Bellman Ford Algorithms.

Design of Efficient Algorithms: Dynamic programming: Matrix Chain Multiplication, Longest Common Subsequence, Multi Stage Graph and 0/1 Knapsack Problem, all Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Backtracking, Branch and Bound: Traveling Salesman Problem and Lower Bound Theory, Graph Coloring, n-Queen Problem and Hamiltonian Cycles.

Comparative study of Sorting Algorithms - Radix sort, Heap sort, Merge sort, Quick sort and Topological Sort. Order statistics and expected time for order statistics. Advanced Trees - Definitions, Operations on Weight Balanced Trees, Huffman Trees, 2-3 Trees and Red- Black Trees.

Graph Theory Algorithms - Algorithms for Connectedness, finding all Spanning Trees in a Weighted Graph and Planarity Testing, Breadth First and Depth First Search, Vertex cover problem. Polynomial Time Solvable problems, Reductions and Completeness, Definition and Interpretation of NP-Completeness, The P vs. NP, Algorithmic Approaches to NP-Complete Problems.

CSE 612A: DATA SCIENCE AND ANALYTICS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to data science: Overview and need of Big Data, The role of Big Data, Big Data Driven Business Models, Challenges, Statistics and descriptive Statistics, Random variables and Probability Distributions. Inferential Statistics: Inferential Statistics through hypothesis tests, Permutation & Randomization Test.

Pattern Recognition Basics: Problem Definition, Representation of input, Training & Test datasets, Distance Metrics & Similarity Measures – Euclidean Distance, Mahalanobis Distance. Correlation & Higher Order Measures. Error Estimation.

Supervised Learning - Regression and Classification, Model Validation Approaches, Linear & Logistic Regression, Decision Trees, Support Vector Machines, Ensemble Methods: Random Forest, Neural Networks. Unsupervised Learning and Challenges: Clustering, K-means, EM algorithms, Mixture of Gaussians, Associative Rule Mining.

Perceptrons & Neural Network Learning – Feed Forward & Back Propagation Neural Networks. Maximum likelihood and gradient descent parameter estimation, Cross validation, Measuring classifier accuracy, Confusion Matrices. Overfitting, Underfitting, Regularization. Bias and Variance.

Data Visualization Graph Visualization, Data Summaries, Model Checking & Comparison. Creating data for analytics through designed experiments, creating data for analytics through Active learning, creating data for analytics through Reinforcement learning. Introduction to Data Governance and Data Pipelines in enterprise systems.

CSE 613 A – SOFTWARE ENGINEERING (M)

3L, 1T

3 Hours, 80 Marks

Taxonomy of Software Development Life Cycle. Models – Waterfall, Spiral, Prototype, Agile, TSP, Extreme Programming. Introduction to Scrum terminology – Product backlog, Increments, ScrumMaster, Sprint, Velocity. Understanding Requirements. Functional and Non-Functional Requirements. Requirements Elicitation. User vs System Requirements. Requirement Specification.

Software Design: Identifying Actors, Use cases and Actions. Identify Objects & Classes. Generalization, Specialization, Aggregation & Relationships. Class Diagrams. Modelling interactions using Sequence Diagrams. Modelling processes using Activity and State Chart Diagrams. Modular Design – Coupling and Cohesion. Design Principles – STUPID, SOLID, GRASP.

Software Architecture – Importance and Views. Architectural Styles – Client-Server, Component Based, Domain Driven, MVC, Layered, N-Tier, Object-Oriented, Service-Oriented, RESTful and Microservices Architecture. Introduction to XaaS and Cloud. Component and Deployment Diagrams. Software Metrics – LoC, FP, Complexity.

Implementation Challenges. Reuse - Design Patterns (Bridge, Adapter, Strategy, Factory, Command, Composite, Decorator, Proxy, Observer). Version Control – Git. Code Quality – Readability, Documentation and Plagiarism. Globalization – Character Sets, Timezones, Currencies, Laws and Taxation. Personalization – User Preferences, Demographic, Device Specific, Privacy.

Importance of Software Quality Assurance. Software Reviews, Test-Driven Development. Unit Testing. Black & White box testing. Functional Tests. Introduction to Test Automation with JUnit. Software Acceptance. Verification and Validation.

ELECTIVE – I

ELECTIVE GROUP (Stream) : COMPUTER SCIENCE

CSE 531 A – ROBOTICS & EMBEDDED SYSTEMS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to Automation and Robotics, present and future applications, classification by coordinate system. Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom, requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Motion Analysis: Homogeneous transformations as applicable to rotation and translation numerical problems. Manipulator Kinematics: Specifications of matrices, D-H notation joint

coordinates and world coordinates. Forward and inverse kinematics numerical problems. Trajectory planning and avoidance of obstacles, path planning, Robot actuators and feed back components: position sensors – potentiometers, resolvers, encoders and velocity sensors.

Introduction to Embedded systems, Applications of Embedded Systems, Software tools, Microcontroller Families, Introduction to AVR microcontrollers, Interfacing of: LEDs, Switches, Relays, LCD, 7 Segment Display, ADC, Stepper Motors, DC Motors, IR Sensors, Serial Communication, GSM module, GPS module, I2C devices, PWM Techniques, Cross Compilers.

Mini software/hardware/simulation project.

CSE 532 A – MICROPROCESSORS (M)

3L, 1T

3 Hours, 80 Marks

An introduction to 80x86 microprocessor family, Real and Protected mode Operation, S/W model of 80x86 family, processor registers, data organization, Instruction types, addressing modes, interrupts, a comparative study of 8086, 80286, 80386, and Pentium.

Software Architecture, Addressing modes, Flags, Data transfer and string instructions, arithmetic, logical, bit manipulation, program transfer and processor control instructions.

Use of assembler directives, Using macros, instruction execution time, Interrupt Processing, working with interrupt vectors, Use of BIOS and DOS function calls, using disks and files.

Protected mode operation, Segmentation, Paging, Protection, Multitasking, Exceptions, Virtual- 8086 mode, Protected mode applications, An introduction to supporting chips and interfacing - 8255, 8279, 8253, 8259, 8257 (their advanced versions). Interfacing assembly with C- language.

ELECTIVE GROUP (Stream) : APPLICATION DEVELOPMENT

CSE 541 A – HUMAN COMPUTER INTERACTION (M)

3L, 1T

3 Hours, 80 Marks

HCI Foundation: History & Motivation. Concept of Usability. User Centered, User Interface and User Interaction Design. Understanding users – Human Factors – cognition, memory, emotions, psychology, perception, context and culture. GOMS Model. Needfinding & Discoverability strategies, Importance of Prototyping – Methods of Rapid Prototyping. HCI Principles and Guidelines.

Interaction Design Basics: Evolution of Paradigms, Input Modes, Interactive Picture Construction Techniques. Visual Design and Layouts. Grids & Alignment, Typography, Colors, Error Messages. Sketches & Wireframes. UI Design Patterns. Introduction to Multi-modal Interaction: Vision, Voice, Haptics. Extended Reality – Virtual & Augmented Reality. Case Study on Design Language Systems – Material UI/Flat UI/Fluent UI.

Model-Based Design. Formal, Cognitive and Synthetic Models. Norman's Interaction Model. Norman's Design Principles. Fitt's Law, Hick-Hyman law. Persuasive Design – Forms of Persuasion, Rhetorics, Loss Aversion, Scarcity, Social factors, Gamification & Rewards, Sustaining attention. Understanding application domains such as Healthcare, Government etc.

User Interface Evaluation: Heuristic & Empirical Approaches. Nielson's Heuristics. Cognitive Walkthrough. Case Study on User Interface Evaluation. Object Oriented Modeling of User Interface Design. Evaluation through expert analysis and user participation. Choosing an evaluation method.

HCI in SDLC. Interactive SDLC. Modelling Interactions. Separation of UI/UX and MVC Architectures. Introduction to CSS Frameworks & Templating Engines. Mobile-First & Adaptive Design. Animation & Motion Graphics. BioSignals (EEG, ECG etc.) and HCI.

CSE 542 A – PROFESSIONAL PRACTICE, CYBER LAWS & ETHICS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to Professional Practice. Graduate Attributes, Expectations and Program Educational Objectives. Introduction to Professional Bodies & Societies – IEEE, ACM, CSI, IET, MeiT, DST (Central & State), NASSCOM etc. Corporate Career vs Entrepreneurship.

Concept of Ethics, Values and Morality. Concept of Harmony, Co-Existence and Social Responsibility. Ethical Conflicts and Case Studies. Ethics for Students – Discipline, Plagiarism, Responsibilities, Safety, Bias & Discrimination, Harassment. Ethics for Innovation, Peer Learning and Productivity. Sustainable Development and Environmental Ethics. Concept of 5Rs. Ethics for Software Professionals – ACM/IEEE Software Engineering Code of Ethics and Professional Practice.

Professional Practices – Concept and Case studies for Ego Management, Leadership, Sharing of Resources, Confidentiality, Privacy and Digital Divide at work. Work Etiquettes for In-person meetings, Virtual Communications (Audio, Video & Emails), Social Media, Body Language and Corporate Dining. International Etiquettes – Language, Timezones, Holidays & Customs.

Industry Practices – Case studies on Corporate Structure, Values, Policies and Employee Code of Conduct. Introduction to Software Documentation & Contracts. Proprietary & Open Source Licensing Models. Basics of Software Requirements, Quality, Version Control and Risk Management. Introduction to ISO/IEC/IEEE 12207, IEEE 830-1998, CMMI and Six Sigma. Lifelong Learning for CS professionals – Need, Resources and Approaches. Introduction to Compliance Audits – ISO 27001, CISSP and CISSA.

Cyber Laws - Cybercrimes and Cyber security, Need of Cyber laws, The Indian IT Act, 2000 and its amendments. Challenges to Indian Law and Cybercrime Scenario in India. Intellectual Property Rights – Patents, Trademarks, Trade Secrets, Designs, Copyrights. Breach of IPR and remedies. Data Protection Laws in India. Case Studies on IPR and Cybercrime lawsuits.

ELECTIVE GROUP (Stream) : NETWORK & INFRASTRUCTURE

CSE 551 A – CLIENT SERVER COMPUTING (M)

3L, 1T

3 Hours, 80 Marks

Introduction: Client/Server architecture, Benefits, application, centralize multiuser, Distributed single user architecture, distributed computing environment.

Approach to Distribution: Distributed models, multi-tier environment, cooperative processing, application components, and distribution points. Presentation distribution, distributed processing, distributed function and transaction processing, data distribution.

Client technologies: Function, Application and tools, operating system, hardware platforms, database access, interprocess communication tools.

Server technologies: Function, server operating system, hardware platforms, data access, distributed data access, database engines.

System networks Architectures: Components, layers, peer-to-peer communication between SNA layers. Data Management: Distributed data management, method of the distribution, distributed data access. Database transaction management.

Distributed DBMS: Architecture, storing data in a distributed DBMS, Distributed catalog, management, Distributed query processing, Update distributed data. Introduction to distributed transactions, distributed concurrency control, and distributed recovery.

CSE 552 A – CYBER SECURITY (M)

3L, 1T

3 Hours, 80 Marks

Basics of Cyber Security: Authorization and Authentication - types, policies and techniques. Security certification and Auditing, Security Requirements Specifications. Firewalls, IDS, Log Files, Honey Pots. Human factors – Security awareness, training, Email and Internet use policies. Security Aspects - Bluetooth security, Wi-Fi security, Wi-Max security, Security in mobile telecommunication network. Security of IP-based network, Security in Adhoc network, Security in IoT Networks.

Application security - Key Problems - Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals. Handling user access, Validating user input. Web Application Security - HTTP Attacks. Attacks on Session Token Generation, Token Handling, Session Management. Attacking Access Control - Vulnerabilities, Attacks and Countermeasures. Attacking Application Logic - Fooling a Password Change Function, Abusing a Search Function.

Hacking Fundamentals – Ethics, Reconnaissance, Scanning and Enumeration. Sniffers, ARP poisoning and MAC Flooding, Denial of Service, Session Hijacking, Social Engineering Web server-working, vulnerability and attack, Web Application Penetration Testing, Structure of Penetration Testing, reverse engineering (using debuggers such as ollydbg or immunity debugger).

Security Technologies - PC & Mobile security, Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft.

Cloud & Biometric Security - Cloud architecture model – SPI framework, XaaS Services, Deployment models. Cloud security design principles, Virtualization security Management- Virtual threats, VM security recommendations, VM security techniques – hardening, securing VM remote access. Biometric Security: Strong Authentication with Single Sign-On (SSO), Concepts of Fingerprint Recognition, Face Recognition, Voice Recognition and Iris Recognition. General Spoofing Techniques.

CSE 553 A – LINUX OPERATING SYSTEM (M)

3L, 1T

3 Hours, 80 Marks

Introduction to Linux, Architecture of Linux Operating System, booting, login, Linux basic commands, disk related command, File system hierarchy, users, groups and permissions.

Shell Scripting-Command line arguments, variables, operators, flow control statements, loops, string handling, and functions.

File system – Structure of file system, descriptors, Files and Inodes, Access permission, ownership, sticky bit, directories, system calls for file processing like ,open, create, close, lseek, read, write, stat, fstat, chmod, chown, link, unlink.

Process management, creation, identification, termination, Zombie process, context of a process, process attributes, user identification, states and priorities, layout of system memory, regions, pages and page tables. System calls like fork, exec, wait, nice, exit.

Signals, signal handling, sending, receiving, blocking, system calls like signal, kill, sleep. Interprocess Communication, pipes, FIFOs, sockets.

System Administration, root login, super user, configuration files, GUI and command line modules for system administration, monitor of system performance. Creating users and groups and user managements. Linux security issues.

Internet and web service tools- connection with Internet, Remote Login and FTP. Linux networks, Introduction to various server setups.

ELECTIVE – II

ELECTIVE GROUP (Stream) : COMPUTER SCIENCE

CSE 631 A – COMPILER DESIGN (M)

3L, 1T

3 Hours, 80 Marks

Introduction to phases and passes of compiler. Introduction to automata theory. Concept of grammar and languages. Chomsky Classification. Introduction to Regular Expressions, Regular Grammar, Context Free Grammar. Introduction to Finite Automata. Regular expressions acceptability by DFA and NFA.

Lexical Analysis, Input Buffering, Specification and Recognition of Tokens keywords and reserve word policies. Syntax Analysis, Top Down Parsing, Recursive Descent Parser, LL(1) parser. Bottom up parsing. Syntax Directed Translation schemes, Dependency Graph, Construction of syntax trees.

Error Handler - Errors, lexical phase errors, syntactic phase errors. Symbol Table Management - Symbol tables, Operation on symbol tables, symbol table organisation.

Intermediate languages, Postfix notation, Three Address Codes - Quadruples, Triplets and Indirect Triplets. Translation of Assignment Statements, Boolean Expressions, Flow Control statements, Array References. Code Optimization, Sources of Optimization, Loop Optimization, DAGs and Optimization of basic blocks.

Runtime Storage Management, Storage Allocation and Referencing data in Block structured languages. Code Generation - a Machine Model, Next Use Information, Register Allocation and Assignment, A Simple Code Generator.

CSE 632 A – ADVANCED DBMS (M)

3L, 1T

3 Hours, 80 Marks

Comparison between file systems, relational, distributed, centralized and object-oriented databases. SQL Statements for Constraints, Transaction Control & Triggers. Stored Procedures.

Storage and Indexing – Concepts. Organization of Records, Data-Dictionary Storage, Column-Oriented Storage. Ordered Indices, Hash Indices & Bitmap Indices. B-Trees and B+ Trees.

Query Execution – Concept of Query Cost, Execution of selection, sorting, joins and expressions. Query Optimization - Heuristics in Query Optimization, Semantic Query Optimization. Multiquery optimization and applications. Query Processing for SQL Updates.

Non-Relational Databases – Object-Oriented Databases – Modelling Objects, Classes, Inheritance and Type hierarchies, Storage issues. NoSQL Databases – Key-Value Pairs, Columnar and Document Databases. Performance and Applications.

Database System Architectures – Centralized, N-Tier, Parallel, Distributed and Cloud-Based databases. Architecture selection strategies. Introduction to Main-Memory Databases.

Case Study of open-source and commercial databases – MySQL, DB2, PL/SQL, Oracle, MongoDB.

CSE 633 A – IMAGE PROCESSING & COMPUTER VISION (M)

3L, 1T

3 Hours, 80 Marks

Imaging Concepts: The Pinhole Camera Model, Camera Calibration, Digital Images - Raster & Vector Images. Photometry, Shading and Illumination Models – Ambient, Diffuse & Specular. Anatomy of Human Vision. Color Perception – Trichromatic Color Models and Visible Light Spectrum.

Image Processing in Spatial and Frequency Domain. Image Filters. Convolution and Linear Filters. Histogram, Color and Pixel level operations. Thresholding. Non-Linear and Morphological Operations. Geometrical Operations. Gaussian, Wavelets and Gabor Filters. Computer Vision Concepts. Introduction to Vision Problems – Categorization,

Classification, Segmentation, Feature Detection, Object Recognition & Tracking, Labelling and Annotation, Image Registration, Restoration, and Content Based Retrieval. Stereo Vision.

Basics of Pattern Recognition. Image Features – Local vs Holistic. Feature Extraction – Template Based, HoG, Haar, Horris, LoG DoG, SIFT, Bag of Words. Dimensionality Reduction - PCA, LDA, ICA. Challenges in Image Classification. Introduction to Precision, Recall and Confusion Matrix.

Learning filters through Supervised Learning. Application of CNNs, RNNs and LSTM in Computer Vision. Case Study of AlexNet, GoogLeNet, ResNet, YOLO. Generative Adversarial Networks & their applications. Introduction to OpenCV, Keras and PyTorch.

ELECTIVE GROUP (Stream) : APPLICATION DEVELOPMENT

CSE 641 A – MOBILE APPLICATION DEVELOPMENT (M)

3L, 1T

3 Hours, 80 Marks

Web, Native and Cross-Platform Development. Introduction to Android Software Stack and Architecture, DVM.. Installing and configuring Android SDK and Android Studio. Design Considerations for mobile devices. Android Virtual Device, Emulators, DDMS, Android Debug Bridge (ADB). Types of Android Applications. Introduction to Services, Broadcast Receiver, Fragments and Intents.

Basics of Android Application Development - Launch Configurations, Execution and Debugging. Android Application Life Cycle – Application, Activity and Manifests, Life Cycle Events. Resources - Values, Styles, Themes, Layouts etc. Separating Resources from logic. Creating resources for different devices and locales.

Application User Interface – Views and Layouts. Optimizing Layouts. Drawable Views. Android UI Controls. Event Listeners & Event Handlers in Android. Adapters, ListView and Spinner. Menus and Menu Hierarchies, Context Menus and Popup Menus. Dialog - Alert Dialog Class, Activities as Dialogs, Toasts and Notifications.

Application Data - Application Preferences, Shared Preferences, File Handling, Files as Resources. Introduction to SQLite - Cursors and Content Values. Working with SQLite Databases - Content Providers, CRUD Operations. Native Android Content Providers.

Accessing Web Content and RESTful data sources, Introduction to Firebase. Introduction to Google Play Services. Submitting an application to Google Playstore. Introduction to maps & location services.

CSE 642 A – .NET TECHNOLOGIES (M)

3L, 1T

3 Hours, 80 Marks

Overview of Microsoft .NET framework, CLR, Framework Class Library, Undocumented Types. Use of Assemblies, Global Assemblies, Namespaces and DLLs. Configuring IIS and Visual Studio for VC# and ASP.NET development. Introduction to .NET Core.

Introduction to Visual C#.NET – Language Fundamentals, Data types, Classes & Interfaces, Properties, Inheritance & Overloading, Operators, Strings, Collections. Exceptions. File Handling – Files & Directories. Creating user interface, UI components. Delegates and Events. Multithreading and Thread Synchronization, Monitors.

Introduction to ASP.NET. Overview of WebForms, MVC, ASP.NET Web Pages and ASP.NET Web API. ASP.NET Architecture, Page Life Cycle, and ASP.NET controls. Validating User Input, Custom Server and User Controls. Designing webpages, navigation, layouts and master pages. ASP.NET Features – Auto Postback, Serialization, Graphics, Rich Client Applications, Configuration.

Introduction to LINQ and ADO.NET - Creating a Connection to the Database, Displaying a DataSet, List-Bound Control, DataGrid Control, Accessing Data with Data Adapters, Data Readers and SqlDataReader. Overview of Stored Procedures.

State management, Application and Session Variables, Cookies and Cookieless Sessions. Using the Cache object. Authentication methods, Localization & User Profiles. ASP.NET Web Services: Overview of XML Architecture. XML Web Server Controls, Creating web services. AJAX.NET: UpdatePanel, ScriptManager, UpdateProgress and Timer Controls. AJAX Control Toolkits.

CSE 643 A – MULTIMEDIA (M)

3L, 1T

3 Hours, 80 Marks

Introduction to multimedia and its applications, Basic requirements for multimedia, Multimedia building blocks – Text, Sound, Images, Animation, Video and related Tools. Concepts of Hypertext/Hypermedia, Multimedia Applications, Authoring tools, Hardware, Image file formats their types and conversions. Sound file formats their types and conversions. MIDI Files, Generating sound. Virtual Reality and its industrial Aspects. CD rendering standards for Text, Audio and Video. Basic idea of DVD technology. Multimedia APIs, Waveform and Auxiliary audio, MIDI, Audio mixers, Media Control Interface (MCI), Multimedia File I/O, AVI File I/O, Joystick, Timers
3D Graphics fundamentals, real-time 3D, non-real-time 3D,
OPENGL: Introduction to the OpenGL API, Drawing shapes, Animation, double buffering. Drawing in 3D-space: Lines, Points and Polygons, Moving around in space: Coordinate transformations, Color, Lighting, and material, Raster graphics in OpenGL. Texture mapping, 3D modeling and object composition. Visual effects: Blending and Fog. Basic idea of Interactive graphics.

ELECTIVE GROUP (Stream) : NETWORK & INFRASTRUCTURE

CSE 651 A – CLOUD COMPUTING (M)

3L, 1T

3 Hours, 80 Marks

Overview of Computing Paradigm : Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, Evolution of cloud computing, Business driver for adopting cloud computing. History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards.

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Deployment Models & types of cloud.

Infrastructure as a Service(IaaS) :Introduction to IaaS, Virtualization, Approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Resource Virtualization, Server, Storage, Network, Virtual Machine(resource) provisioning and manageability, Data storage in cloud computing, storage as a service. Platform as a Service(PaaS) :Introduction to PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation, Storage, Examples, Google App Engine, Microsoft Azure, Salesforce platforms.

Software as a Service(PaaS) : Introduction to SaaS, Web services, Web 2.0, Web OS. Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing

Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations. Case Study
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on Open Source & Commercial Clouds: Examples - Open stack, Microsoft Azure, Amazon AWS, Google Cloud.

CSE 652 A – WIRELESS TECHNOLOGY (M)

3L, 1T

3 Hours, 80 Marks

Introduction to Wireless Communication, Basics of Radio Transmission – Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems. Medium Access Control, Comparison of S/T/F/CDMA.

Telecommunication systems, Mobile Services & System Architecture, Radio Interface – Protocols, Localization and Calling, Handover, Security, Data services. Satellite Systems - Broadcast systems, Audio & Video Broadcasting. WDM, Optical networks.

Wireless LAN - Infrared Vs Radio transmissions, Infrastructure and Adhoc networks, IEEE 802.11 b/a/g, Bluetooth, IEEE 802.16. Mobile Network Layer, Mobile IP, Packet Delivery, Registration, Tunneling and Encapsulation. Optimizations, Reverse tunnelling, DHCP.

Adhoc networks - Routing algorithms, Metrics, Mobile transport layer, Mobile TCP, Indirect TCP, Snooping TCP, Retransmission, Recovery. Transaction Oriented TCP, File Systems.

Introduction to WWW & WAP Architecture - Datagram Protocol, Transport Security, Transaction Protocol, Session Protocol, Application environment. WML - scripts - wireless telephony applications. Overview of VoIP.

ELECTIVE – III

ELECTIVE GROUP (Stream) : COMPUTER SCIENCE

CSE 731 A – BIG DATA ANALYTICS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to Big Data – Traits of Big Data. Introduction to Distributed file systems. Need and importance of Big Data. Challenges of Conventional Systems. Drivers of Big Data. Analytic Processes and Tools - Analysis vs Reporting.

Big Data Storage – Introduction to Apache Hadoop, History of Hadoop. Hadoop Distributed File System (HDFS), Architecture and Goals. Namenodes and Datanodes. Federation. Storing and Retrieving Data. Hadoop Data flow, Data Ingest with Flume and Sqoop. Hadoop Archives.

Hadoop Ecosystem: MapReduce – Architecture, Goals & Features. MapReduce Jobs & Design Patterns. Job Scheduling and Failures, Task Execution, Types and Formats. Introduction to YARN – ResourceManager, NodeManager, ApplicationMaster, Containers. Overview of Hive, Pig, HBase, ZooKeeper and Cassandra.

Big Data Processing – Stream Data Model and Architecture, Stream Computing, Filtering Streams. Introduction to Apache Spark: Architecture & Applications. Introduction to Apache Kafka, Spark vs Kafka, Architecture & Applications. Big Data Visualization – Challenges and Applications. Visual Thinking and Visual Analysis Reference Model. Visualizing Structured, Unstructured, Multi-dimensional, Spatial and Temporal data. Overview of D3.js and Tableau.

Big Data Analytics – Classification – Naïve Bayes, Decision Trees. Clustering- K-Means and Hierarchical, Determining the Number of Clusters, Diagnostics. Association Rules, Apriori Algorithm, Applications of Association Rules. Introduction to Recommender Systems, Time Series Analysis, Forecasting, Anomaly Detection and Graph Analytics. SparkML – Pipeline and applications.

CSE 732 A – ADVANCED COMPUTER ARCHITECTURE (M)

3L, 1T

3 Hours, 80 Marks

Introduction to parallel processing and trends: parallelism in uni-processor system, parallel computer structure, architectural classification schemes for parallel computers, multiplicity of instruction – data streams, serial versus parallel computers, parallelism versus pipelining.

Memory hierarchy: hierarchical memory structures, virtual memory system, memory allocation and management. Structure for array processors: SIMD computer organization, masking and data routing mechanism Inter PE communication, introduction to associative array processing.

Principles of pipelining: pipelining principles and classifications, general pipelines and reservation tables, interleaved memory organization, instruction pre-fetch and branch handling, data buffering and busing structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, dynamic pipelines and reconfigurability.

Multiprocessor architecture: loosely coupled and tightly coupled multiprocessors, processor characteristics for multiprocessing, interconnection networks, cache coherence protocols.

Introduction to advance processors: Data flow computers, the VLIW architecture, fault tolerant architecture and study of TANDEM HIMALAYAN K2 system architecture.

CSE 733 A – SOFT COMPUTING (M)

3L, 1T

3 Hours, 80 Marks

Soft Computing : Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Propositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Neural Network : Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm.

Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

ELECTIVE GROUP (Stream) : APPLICATION DEVELOPMENT

CSE 741 A – MODERN WEB DEVELOPMENT (M)

3L, 1T

3 Hours, 80 Marks

Components of Web Applications – Business Logic, Application Layer and Presentation Layer.

HTML5 Features – WebStorage (Local and Session Storage), App Cache, Web Workers, Server-Sent Events, Geolocation, Web Sockets, WebSQL Databases. Responsive Page Design – CSS Media Queries, Flexbox API.

Web Page Optimization. Page Speed Metrics, HTTP Caching – Cache-Control and ETags, HTTP Compression – Apache mod_deflate, Minification, CSS Sprites, Redirects, JS Optimizations.

API First Development – Concepts, Pros & Cons. RESTful APIs using JSON and XML. Progressive Web Apps – Service Workers, Cache API, Firebase Integration, Push Notifications.

Advanced PHP – Object-Oriented PHP Libraries, Typehints, Autoloaders, Composers, Front Controllers, PDO. Introduction to MVC and Templating Engines – Smarty.

Introduction to Containers, Hypervisors, CI/CD Pipelines. Introduction to Microservices and Serverless Architectures.

CSE 742 A – GEOGRAPHICAL INFORMATION SYSTEMS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to GIS and Geographical Information: Basic concepts, Socioeconomic Challenges, Benefits of Computerizing Information, Users of GIS. From Real world to GIS: The real world, Real-world model, Data model, from database to GIS to Map, Application of GIS.

Basic Data models: Introduction, Vector data model, raster data models, conversion between vector and raster models, vector vs raster models. Attribute data. Advanced data models: surface representation, three dimensional objects, representation of time. Global Positioning System: Introduction, History, GPS System Description, Structure of GPS system, GPS Accuracy and Error, Introduction to DGPS.

Data collection: Introduction, digitizing maps, scanning, aerial photographs and photo interpretation, Remote sensing. Surveying, satellite positioning systems, photogrammetric mapping, collection of attribute data, text data. Data input: data pre-processing, methods of data capture, digitization and scanning methods, commonly used map projections and ellipsoids.

Basic spatial analysis: Analysis of spatial information, logic operations, general arithmetic and statistical operations. Report generation from attribute data. overlays, buffer zones, raster data overlay. Integrated data analysis.

Digital Elevation Model (DEM): need, methods, data sources and products of DEM - Digital Terrain Modelling (DTM) - Input verification, storage and methods of data analysis for Spatial modelling - Methods of GIS and Spatial interpolation.

ELECTIVE GROUP (Stream) : NETWORK & INFRASTRUCTURE

CSE 751 A – BLOCK CHAIN (M)

3L, 1T

3 Hours, 80 Marks

Introduction, The consensus problem, Asynchronous Byzantine Agreement, AAP protocol and its analysis, Nakamoto Consensus on permission-less, nameless, peer-to-peer network, Abstract Models for Block chain, 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).

Cryptographic basics for crypto currency, a short overview of Hashing, Signature schemes, encryption schemes, public key crypto, verifiable random functions, Zero-knowledge systems.

Bitcoin, Wallet, Blocks, Bitcoin Data Structures, Merkle Tree, LPV nodes, hardness of mining, transaction verifiability, anonymity, forks, double spending, Mathematical analysis of properties of Bitcoin.

Ethereum, Ethereum Virtual Machine (EVM), EVM Data Structures, Alternative Data Structures, Wallets for Ethereum, Solidity, Solidity pitfalls and disasters, Smart Contracts, Some attacks on smart contracts, ICO token, Cryptokitties.

Trends and Topics - Permissioned Blockchains, Hyperledger Fabric, Concurrent Contract Execution, Zero Knowledge proofs and protocols in Blockchain, Zcash, Succinct non interactive argument for Knowledge (SNARK), pairing on Elliptic curves.

CSE 752 A – INTERNET OF THINGS (M)

3L, 1T

3 Hours, 80 Marks

Introduction to IoT, Architectural Overview, Design principles and needed capabilities, IoT Applications. Sensing and Actuation. IoT sensors – motion (location, acceleration, direction and orientation), environmental (temperature, humidity, pressure), chemical (water quality and gas), physical (proximity, smoke, water level, reed switch) and perception (optical, infrared, auditory) sensors. IoT Actuators – Motors (Servo, Stepper, DC, Linear), Relays, Solenoids.

Basics of Networking. Devices and Gateways. Communication Protocols – BLE, WiFi, ZigBee, LoRa, NFC. Data Protocols – MQTT, AMQP, CoAP & XMPP. Wireless Sensor Networks. Machine-to-Machine Communications (M2M). Interoperability in IoT.

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Raspberry Pi. Implementation of IoT systems using Raspberry Pi. Connecting RPi to internet. Running Python programs on RPi. Server Components – Client-Server and RESTful architectures. Introduction to SDN, SDN for IoT. Cloud Architectures - Sensor-Cloud, Fog & Edge Computing. Energy Efficiency, QoS, QoE and Everything as a Service (XaaS). Unstructured vs Structured Data Storage. Searching and Data Analytics in IoT. Authentication & Authorization, Business Processes in IoT, Security in IoT, Data Governance & Privacy. Big Data in IoT. Case Studies - Smart Cities and Smart Homes. Connected Vehicles, Smart Grid, Industrial IoT. Internet of Medical Things. Case Study: Agriculture, Healthcare, Activity Monitoring.

CSE 753 A - COMPUTER NETWORK MANAGEMENT (IT)

3L, 1T

3 Hours, 100 Marks

Introduction to network management, challenges of information Technology managers. Network management goals, organization and functions. Network operations and NOC (Network operation center).

Network installation, Maintenance, current status, Network management standards, models, organization model, Information model, management information tree. Internet Organizations and standards, Internet documents.

SNMP model, communication model, architecture, protocol Specifications, operations.

Introductory idea of ISDN, ATM based network and management.

Network management tools and systems, BERT (Berkeley e-mail replacement tool), Basic software tools, SNMP and MIB (management information base) Tools, protocol analyzer, Traffic load Monitoring.

Web based management, Web interface and Web Management. Local and remote access. Embedded Web Based management.

Network management applications, configuration management Inventory management, fault management, fault detection, fault location and isolation Techniques.

Security management policies and procedures, Resource to prevent security Breaches, Report Management, Policy Based management.