Course Title: DISTRIBUTED COMPUTING Course Code: DA7010

Credit: 3

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Year: 4th Semester: VII

Unit I : **Fundamentals of Distributed Computing:** Introduction to distributed computing Systems, Resource
sharing and the Web Challenges.
**System Models:** Architectural models, Fundamental Models
**Theoretical Foundation for Distributed Computing System**: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection.

Unit II : **Distributed Mutual Exclusion**: Classification of distributed mutual exclusion, requirement of mutual
exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms.
**Distributed Deadlock Detection**: system model, resource Vs communication deadlocks deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.

Unit III : **Distributed Objects and Remote Invocation**: Communication between distributed objects, Remote
procedure call, Events and notifications, Java RMI case study.
**Distributed File Systems**: File service architecture, Sun Network File System, The Andrew File System, Recent advances.

Unit IV : **Transactions and Concurrency Control**: Flat and nested distributed transactions, Locks, Optimistic Concurrency
control, Timestamp ordering, Comparison of methods for concurrency control.
**Distributed Transactions**: Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Atomic Commit protocols.

Unit V : **Introduction to Grid Computing:** Basics of grid Computing, Benefits of grid computing, Grid terms and concepts,
Grid user roles, Standards for grid environments, Grid security requirements.
**Introduction to Parallel Processing:** Basic Concepts: Introduction to parallel processing, parallel processing terminology, Parallel & Distributed Programming: Parallel Programming environments

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## Text Book:

1. Tannenbaum, A, Van Steen. Distributed Systems, Principles and Paradigm , Prentice Hall India, 2002

2. Tannenbaum, A. Distributed Operating Systems, Pearson Education. 2006

## Reference Book:

1. Attiya, Welch, “Distributed Computing”, Wiley India, 2006

2. Singhal and Shivaratri, “Advanced Concepts in Operating Systems”, McGraw Hill, 1994

3. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design”, Pearson Ed.

Course Title: ADVANCED COMPUTER ARCHETECTURE Course Code: DA7020

Credit: 4

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Year: 4th Semester: VII

***UNIT 1*** ***(6L)***

**Introduction:** Parallel Computing, Parallel Computer Model, Program and Network Properties, Parallel (Architectural Classification Schemes, Flynn's & Feng's Classification, Performance Metrics and Measures, Speedup Performance Laws: Multiprocessor System and Interconnection Networks; IEEE POSIX Threads: Creating and Exiting Threads, Simultaneous Execution of Threads, Thread Synchronization using Semaphore and Mutex, Canceling the Threads.

***UNIT 2*** ***(9L)***

**Pipelining and Memory Hierarchy:** Basic and Intermediate Concepts, Instruction Set Principle; ILP: Basics, Exploiting ILP, Limits on ILP; Linear and Nonlinear Pipeline Processors; Super Scalar and Super Pipeline Design; Memory Hierarchy Design: Advanced Optimization of Cache Performance, Memory Technology and Optimization, Cache Coherence and Synchronization Mechanisms.

***UNIT 3*** ***(8L)***

**Thread and Process Level Parallel Architecture:** Introduction to MIMD Architecture, Multithreaded Architectures, Distributed Memory MIMD Architectures, Shared Memory MIMD Architecture, Clustering, Instruction Level Data Parallel Architecture, SIMD Architecture, Fine Grained and Coarse Grained SIMD Architecture, Associative and Neural Architecture, Data Parallel Pipelined and Systolic Architectures, Vector Architectures.

***UNIT 4*** ***(8L)***

**Parallel Computing model:** Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW Models.

***UNIT 5*** ***(9L)***

**Parallel Algorithms:** PRAM Algorithms: Parallel Reduction, Prefix Sums, Preorder Tree Traversal, Merging two Sorted lists; Matrix Multiplication: Row Column Oriented Algorithms, Block Oriented

Algorithms; Parallel Quicksort, Hyper Quicksort; Solving Linear Systems: Gaussian Elimination, Jacobi Algorithm; Parallel Algorithm Design Strategies.

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**Text Book:**


1. Kai Hwang," Advance Computer Architecture", TMH
2. Matthew, "Beginning Linux Programming", SPD/WROX


**Reference Book:**


1. Hennessy and Patterson," Computer Architecture: A Quantitative Approach", Elsevier
2. Dezso and Sima, "Advanced Computer Architecture", Pearson
3. Quinn, "Parallel Computing: Theory & Practice", TMH
4. Quinn, "Parallel Programming in C with MPI and Open MP", TMH

Course Title: CRYPTOGRAPHY AND NETWORK SECURITY Course Code: DA7210

Credit: 4

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Year: 4th Semester: VII

Unit I : Introduction to security attacks, services and mechanism, introduction to cryptography.

**Conventional Encryption:** Conventional encryption model, classical encryption techniques-substitution ciphers and transposition ciphers, cryptanalysis, steganography,stream and block ciphers.

**Modern Block Ciphers:** Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, confidentiality using conventional encryption, traffic confidentiality, key distribution

Unit II : Introduction to prime and relative prime numbers, finite field of the form GF(p), modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elgamel encryption.

Unit III : **Message Authentication and Hash Function:** Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA).Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Unit IV : **Authentication Applications:** Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit V : **IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.

**Web Security:** Secure socket layer and transport layer security, secure electronic transaction (SET).

**System Security:** Intruders, Viruses and related threads, firewall design principals, trusted systems.

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## Text Book:

1. William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.

## Reference Book:

1. Johannes A. Buchmann, “Introduction to Cryptography”, Springer-Verlag.
2. Bruce Schiener, “Applied Cryptography”.

Course Title: DATAWAREHOUSE & DATA MINING Course Code: DA7030

Credit: 3.5

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Year: 3rd Semester: VI

Unit I : Overview, Motivation (for Data Mining), Data Mining-Definition & Functionalities.

**Data Warehousing:** Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting. ROLAP, MOLAP, HOLAP.

Unit II : **Data Pre-Processing**: Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation.

Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Unit III : **Concept Description:** Definition, Data Generalization, Analytical Characterization,

Analysis of attribute relevance, Mining Class comparisions, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases

Unit IV : **Classification:** What is Classification, Issues regarding Classification, Decision tree, Bayesian Classification, Classification by Back propagation.

Unit V : **Cluster Analysis:** Data types in cluster analysis, Partitioning methods. Hierarchical Clustering-CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods- STING, CLIQUE, Outlier Analysis

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## Text Book:

1. Jiawei Han, Micheline Kamber, ”Data Mining Concepts & Techniques” Elsevier

## Reference Book:

1. M.H.Dunham,”Data Mining:Introductory and Advanced Topics” Pearson Education
   Mallach,”Data Warehousing System”,McGraw –Hill

Course Title: Cloud Application development & Storage Virtualization Course Code: DA7610

Credit: 4

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Year: 4th Semester: VII

Unit I

**Cloud Deployment:** Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Application Development: Google App Engine, Introduction to google app engine, using google app engine with Eclipse IDE, Develop a single basic application with google app engine, deploy application over google cloud.

Microsoft Azure- Introduction, develop a Cloud asp.net application, deploy on Azure Cloud.

Amazon Web Services- Amazon EC2, Develop and deploy an application on Azure cloud

Unit II

**Virtualization**: What is virtualization? Tools providing virtualization- VMware, VirutalBox, Advantages and disadvantages of Virtualization, Setting up virtual machine- Linux installation as a server, Setup client-server environment.

Unit III

**Virtualized Data Center Architecture**: Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures.

Unit IV

**Storage Network Design**: Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations.

Unit V

**Cloud Optimized Storage**: Global storage management locations, scalability, and operational efficiency. Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attitudes; file systems or object storage.

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Text Book:

1- Lars Nielsen, "The Little Book of Cloud Computing", New Street Communications by LLC (January 4, 2013).

Reference Book:

1. John Rhoton, "Cloud Computing Explained" by Recursive Press 2nd edition (November 2, 2009).

Course Title: STATISTICAL MACHINE LEARNING Course Code: DA7620

Credit: 4

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Year: 4th Semester: VII

**Unit I** **Introduction:** Probability Theory, Overview of supervised learning, Curse of dimensionality, Decision theory, Information theory, Minimax theory, Parametric versus non-Parametric methods, Bayesian versus non-Bayesian approaches, Classification, Regression, Density estimation, Bias-variance, Lasso, MLE.

**Unit II** **Parametric and Nonparametric Methods:** Linear regression, Model selection, Generalized linear models, Classification, Structured prediction, Hidden Markov models; Regression: Linear smoothers, Variance estimations, Confidence bands, Average coverage, Space-scale smoothing, Multiple regression; Density estimation: Cross-validation, Histograms, Kernel density estimation, Local polynomials, Classification, Bootstrap and sub-sampling, Nonparametric Bayes.

**Unit III** **Kernel Methods and Machines:** Dual representations, Kernel construction, Selecting the width of the kernel, Kernel density estimation and classification, Radial basis functions and kernel, Gaussian processes, Maximum margin classifiers, Relevance vector machines.

**Unit IV** **Graphical and Mixture Models:** Bayesian networks: Generative models, Linear-Gaussian models; Conditional independence: D-separation; Markov random fields: Factorization properties, Relation to directed graphs; Inference in graphical models: Inference on a chain, Trees, Factor graphs, Sum-product & max-sum properties, Loopy belief propagation; K-means clustering, Mixtures of Gaussians, EM, An alternative view of EM.

**Unit V** **Other Learning Methods:** Unsupervised learning, Semi-supervised learning, Reinforcement learning, Ensemble learning, Online learning, Active learning.

**Text Book**

1. Bishop C. M., Pattern Recognition and Machine Learning, Springer (2006), 1st ed.
2. Hastie T., Tibshirani R., Friedman J., The Elements of Statistical Learning, Springer (2008), 2nd ed.

**Reference Book**

1. Wasserman L., All of Statistics: A Concise Course in Statistical Inference, Springer (2010), 1st ed.
2. Devroye L., Gyorfi L., Lugosi G., A Probabilistic Theory of Pattern Recognition, Springer, (1996), 1st ed.

Course Title: Game Engine Architecture

Course Code: DA7630

Credit: 4

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Year: 4th

Semester: VII

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**Unit I** **Foundations:** Introduction to gaming, Game Engine, Engine Differences Across Genres, Game Engine Survey, Runtime Engine Architecture, Tools and the Asset Pipeline, Profiling Tools, Version Control, Memory Leak and Corruption Detection, Fundamentals of Software Engineering for Games.

**Math for Games:** Solving 3D Problems in 2D, Points and Vectors, Matrices, Quaternion's, Comparison of Rotational Representations, Other Useful Mathematical Objects, Hardware-Accelerated SIMD Math, Random Number Generation.

**Unit II** **Low-Level Engine Systems:** Engine Support Systems, Subsystem Start-Up and Shut-Down, Memory Management, Containers, Strings, Engine configuration.

**Resources and the File System:** File System, Resource Manager, Game Loop and Real-Time Simulation, Rendering Loop, Game Loop Architectural Styles, Abstract Timelines, Measuring and Dealing with Time, Multiprocessor Game Loops, Networked Multiplayer Game Loops.

**Unit III** **Human Interface Devices (HID):** Types of Human Interface Devices, Interfacing with a HID, Types of Inputs, Types of Outputs, Game Engine HID Systems, Human Interface Devices in Practice.

**Graphics and Motion:** Rendering Engine, Foundations of Depth-Buffered, Triangle Rasterization, the Rendering Pipeline, Advanced Lighting and Global Illumination, Visual Effects and Overlays.

**Unit IV** **Animation Systems:** Types of Character Animation, Skeletons 496x Contents, Poses, Clips, Skinning and Matrix Palette Generation, Animation Blending, Post-Processing, Compression Techniques, Animation System Architecture, The Animation Pipeline, Action State Machines, Animation Controllers.

**Unit V** **Collision and Rigid Body Dynamics:** Collision/Physics Middleware, The Collision Detection System, Rigid Body Dynamics, Integrating a Physics Engine into Game, Advanced Physics Features.

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**Text Books:**


1. Jason Gregory, Jeff Lander and Matt Whiting, Game Engine Architecture, A K Peters/CRC Press; 2 edition (May 26, 2014)
2. Allen Sherrod, Ultimate 3D Game Engine Design & Architecture, Charles River Media game development (August 24, 2009)


**Reference Books:**


1. Alan Thorn,**Game Engine Design and Implementation, Jones & Bartlett Learning (June 30, 2010)**
2. Luke Ahearn, 3D Game Textures, Focal Press, Third Edition, October 17, 2011
3. Heather Maxwell Chandler, Game Production Handbook, Jones & Bartlett, 2013, 3rd ed.

Course Title: DIGITAL IMAGE PROCESSING Course Code: DA7640

Credit: 4

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Year: 4th Semester: VII

Unit I : **Introduction and Fundamentals:** Motivation and Perspective, Applications, Components of Image Processing
System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.
**Image Enhancement in Spatial Domain:** Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit II : **Image Enhancement in Frequency Domain:** Fourier Transform and the Frequency Domain, Basis of Filtering in
Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.
**Image Restoration:** A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit III : **Color Image Processing:** Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.
**Morphological Image Processing:** Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.

Unit IV : **Registration:** Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms
to Establish Correspondence, Algorithms to Recover Depth

**Segmentation:** Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Regionbased
Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit V : **Feature Extraction:** Representation, Topological Attributes, Geometric Attributes.
**Description:** Boundary-based Description, Region-based Description, Relationship.
**Object Recognition:** Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.

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## Text Book:

Rafael C. Gonzalvez and Richard E.Woods., Digital Image Processing 2nd Edition, Pearson Education.
2. R.J. Schalkoff. ,Digital Image Processing and Computer Vision, John Wiley and Sons, NY.

## Reference Book:

1. A.K. Jain. , Fundamentals of Digital Image Processing, Prentice Hall, Upper Saddle River, NJ.

Course Title: ADVANCED COMPUTER NETWORK Course Code: DA7650

Credit: 4

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Year: 4th Semester: VII

***UNIT I*** ***(8L)***

**Network Design**: Design Principles, Determining Requirements, Analysing the Existing Network, Preparing the Preliminary Design, Completing the Final Design Development, Deploying the Network, Monitoring and Redesigning, Maintaining, Design Documentation, Cisco PDIOO Model, Modular Network Design, Hierarchical Network Design, The Cisco Enterprise Composite Network Model.

***UNIT II*** ***(8L)***

**Router Design**: Configuring a Router, Routing Protocols, **Switching Design**: Switching Types, Layer 2 and 3 Switching, Multilayer Switching, Cisco Express Forwarding, Switching Security, Multi-Protocol Label Switching (MPLS), MPLS Architecture and related protocols. **IPv4 Routing Design**: IPv4 Address Design, Private and Public Addresses ,NAT, Subnet Masks, Hierarchical IP Address Design, Deploying IPv6 in Campus Networks,

***UNIT III*** ***(8L)***

**Wireless LAN Design**: Wireless Technology Overview, Wireless Standards, Wireless Components, Wireless Security, Wireless Security Issues, Wireless Threat Mitigation, Wireless Management, Wireless Design Considerations, IEEE 802.11, Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks(WMNs), QoS Models: IntServ, DiffServ154, QoS Tools, Policing and Shaping, Congestion Avoidance, Congestion Management, Link- Specific Tools, QoS Design Guidelines.

***UNIT IV*** ***(8L)***

**Optical Networks**: Benefits of Optical Networks, Optical Network Drivers, Component Applications, Design and Planning, Restoration, Network Management, WDM System, All-Optical Network, Optical Layer Services and Interfacing.

***UNIT V*** ***(8L)***

**Network Security and Management Design:** Hacking: Vulnerabilities, Threats: Reconnaissance Attacks, Access Attacks, Information Disclosure Attacks, Denial of Service Attacks, Threat Defence Secure Communication, Network Security Best Practices, SAFE Campus Design.

ISO Network Management Standard: Protocols and Tools, SNMP, MIB, RMON, Cisco NetFlow, Syslog, Network Management Strategy: SLCs and SLAs, IP Service-Level Agreements, Content Networking Design.

**Text Book:**


1. Diane Tiare and Catherine Paquet, "Campus Network Design Fundamentals", Pearson Education, 2006.
2. Rajiv Ramaswami, Kumar N Sivarajan, Galen H Sasaki, "Optical Networks, A Practical Perspective", 3rd Edition, Elsevier, 2010.


**Reference Book:**


1. Craig Zacker, "The Complete Reference: Upgrading and Troubleshooting Networks", Tata McGraw-Hill, 2000.