# DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

## MASTER OF COMPUTER APPLICATION (INTEGRATED) 5th Year

On

Choice Based Credit System

(Effective from the Session: 2021-22)

**MASTER OF COMPUTER APPLICATION (INTEGRATED)**

# MCA (INTEGRATED) FIFTH YEAR, 2021-22

## SEMESTER-IX

| S.No. | Subject Code | Subject Name | L-T-P | ESE Marks | Sessional | | Total | Credit |
|---|---|---|---|---|---|---|---|---|
| | | | | | CT | TA | | |
| 1. | RCAI-901 | Computer Graphics | 3-1-0 | 70 | 20 | 10 | 100 | 4 |
| 2. | RCAI-902 | Software Engineering | 3-1-0 | 70 | 20 | 10 | 100 | 4 |
| 3. | **Elective-2** | | 3-1-0 | 70 | 20 | 10 | 100 | 4 |
| 4. | **Elective-3** | | 3-1-0 | 70 | 20 | 10 | 100 | 4 |
| 5. | **Elective-4** | | 3-1-0 | 70 | 20 | 10 | 100 | 4 |
| 6. | RCAI-951 | Computer Graphics Lab | 0-0-3 | 50 | 30 | 20 | 100 | 2 |
| 7. | RCAI-952 | Project Based on Software Engineering Lab | 0-0-3 | 50 | 30 | 20 | 100 | 2 |
| | | **Total** | | | | | **700** | **24** |

**CT**: Class Test **TA**: Teacher Assessment **L/T/P**: Lecture/ Tutorial/ Practical

## SEMESTER-X

| S.No. | Subject Code | Subject Name | L-T-P | ESE Marks | Sessional | | Total | Credit |
|---|---|---|---|---|---|---|---|---|
| | | | | | CT | TA | | |
| 1. | RCAI-1051 | Colloquium | 0-0-8 | - | - | 100 | 100 | 4 |
| 2. | RCAI-1052 | Industrial Project | 0-0-40 | 350 | - | 250 | 600 | 20 |
| | | **Total** | | | | | **700** | **24** |

**CT**: Class Test **TA**: Teacher Assessment **L/T/P**: Lecture/ Tutorial/ Practical

**Elective-2**

1. RCAI021 Cryptography and Network Security
2. RCAI022 Software Testing
3. RCAI023 Natural Language Processing
4. RCAI024 Neural Networks
5. RCAI025 Big Data

**Elective-3**

1. RCAI031 Cloud Computing
2. RCAI032 Soft Computing
3. RCAI033 Deep Learning
4. RCAI034 Distributed Systems
5. RCAI035 Advanced Database Management Systems

**Elective-4**

1. RCAI041 Distributed Database Systems
2. RCAI042 Simulation and Modeling
3. RCAI043 Introduction to Machine Learning
4. RCAI044 Pattern Recognition
5. RCAI045 Android Operating System

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# RCAI901: COMPUTER GRAPHICS

**UNIT-I**

**Introduction and Line Generation:** Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Midpoint circle generating algorithm and parallel version of these algorithms.

**UNIT-II**

**Transformations:** Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

**Windowing and Clipping:** Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows, Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping.

**UNIT-III**

**Three Dimensional:** 3-D geometric primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.

**UNIT-IV**

**Curves and Surfaces:** Quadric surfaces, Spheres, Ellipsoid, Blobby objects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.

**UNIT-V**

**Hidden Lines and Surfaces:** Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, Basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.

***References:***


1. Hearn D. and Baker M. P., “Computer Graphics C Version”, Pearson Education.
2. Maurya R. K., “Computer Graphics”,Wiley Dreamtech Publication.
3. Rogers D.F., “Procedural Elements of Computer Graphics”, McGraw Hill.
4. Mukherjee D.P., “Fundamentals of Computer Graphics & Multimedia”, PHI Learning Pvt. Ltd.
5. Newman W. M. and Sproull R. F, “Principles of Interactive Computer Graphics”, Tata McGraw Hill.

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# RCAI902: SOFTWARE ENGINEERING

**UNIT-I**

**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes, Software Development Life Cycle (SDLC) Models- Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

**UNIT-II**

**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

**UNIT-III**

**Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design- Modularization, Design Structure Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design.

**UNIT-IV**

**Software Testing and Maintenance:** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Alpha and Beta Testing. Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering.

**UNIT-V**

**Software Project Management and Other Software Engineering methodologies:** Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule & Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

***References:***


1. Pressman R. S., “Software Engineering: A Practitioners Approach”, McGraw Hill.
2. Aggarwal K. K. and Singh Y., “Software Engineering”, New Age International Publishers.
3. Jalote P., “Software Engineering”, Wiley.
4. Mall R., “Fundamentals of Software Engineering”, PHI Publication.
5. Mishra J. and Mohanty A., “Software Engineering”, Pearson Education.

# ELECTIVE-2

# RCAI021: CRYPTOGRAPHY AND NETWORK SECURITY

**UNIT-I**
Introduction to security attacks, Services and mechanism, Classical encryption techniques substitution ciphers and transposition ciphers, Cryptanalysis, Steganography, Stream and block ciphers.
Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion, Feistel structure, Data encryption standard(DES), Strength of DES, Idea of differential cryptanalysis, Block cipher modes of operations, Triple DES

**UNIT-II**
Introduction to group, field, finite field of the form GF(p), Modular arithmetic, Prime and relative prime numbers, Extended Euclidean Algorithm, Advanced Encryption Standard (AES).
Fermat's and Euler's theorem, Primality testing, Chinese Remainder theorem, Discrete Logarithmic Problem, Principals of public key crypto systems, RSA algorithm, Security of RSA

**UNIT-III**
**Message Authentication Codes:** Authentication requirements, Authentication functions, Message authentication code, Hash functions, Birthday attacks, Security of hash functions, Secure hash algorithm (SHA).
**Digital Signatures:** Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), Proof of digital signature algorithm.

**UNIT-IV**
**Key Management and distribution:** Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure.
**Authentication Applications:** Kerberos Electronic mail security: pretty good privacy (PGP), S/MIME.

**UNIT-V**
**IP Security:** Architecture, Authentication header, Encapsulating security payloads, Combining security associations, Key management.
Introduction to Secure Socket Layer, Secure electronic transaction (SET).
**System Security:** Introductory idea of Intrusion, Intrusion detection, Viruses and related threats, firewalls.

***References:***

1. Stallings W., "Cryptography and Network Security: Principals and Practice", Pearson Education.
2. Frouzan B. A., "Cryptography and Network Security", McGraw Hill.
3. Kahate A., "Cryptography and Network Security", Tata McGraw Hill.

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# RCAI022: SOFTWARE TESTING

**UNIT-I**

**Review of Software Engineering:** Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference between Verification and Validation, Test Cases, Testing Suite, Test Oracles, Impracticality of Testing All data; Impracticality of testing All Paths. Verification: Verification methods, SRS verification, Source code reviews, User documentation verification, and Software project audit, Tailoring Software Quality Assurance Program by Reviews, Walkthrough, Inspection, and Configuration Audits.

**UNIT–II**

**Functional Testing:** Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Control flow testing, Path testing, Independent paths, Generation of graph from program, Identification of independent paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing.

**UNIT-III**

**Regression Testing:** Introduction, Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique, Prioritization guidelines, Priority category, Scheme, Risk Analysis.

**UNIT-IV**

**Software Testing Activities:** Levels of Testing, Debugging, Testing techniques and their Applicability, Exploratory Testing Automated Test Data Generation: Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan.

**UNIT-V**

**Object oriented Testing:** Definition, Issues, Class Testing, Object Oriented Integration and System Testing. Testing Web Applications- Web testing, User interface Testing, Usability Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing.

***References :***


1. Pressman R. S., “Software Engineering – A Practitioner’s Approach”, Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.
2. Singh Y., “Software Testing”, Cambridge University Press, New York, 2012.
3. Aggarwal K.K. and Singh Y., “Software Engineering”, New Age International Publishers, New Delhi, 2003.
4. Roper M., “Software Testing”, McGraw-Hill Book Co., London, 1994.
5. Beizer B., “Software System Testing and Quality Assurance”, Van Nostrand Reinhold, New York, 1984.

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# RCAI023: NATURAL LANGUAGE PROCESSING

**UNIT-I**

Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

**UNIT-II**

Introduction to semantics and knowledge representation, some applications like machine translation, database interface.

**UNIT-III**

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

**UNIT-IV**

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

**UNIT-V**

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

***References:***


1. Bharti A., Chaitanya V. and Sangal R. "NLP: A Paninian Perspective", Prentice Hall, New Delhi.
2. Allen J., "Natural Language Understanding', Pearson Education.
3. Jurafsky D. and Martin J.H., "Speech and Language Processing", Pearson Education.
4. Winograd T., " Language as a Cognitive Process", Addison-Wesley.

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# RCAI024: NEURAL NETWORKS

**UNIT-I**

**Neurocomputing and Neuroscience**: the human brain, biological neurons, neural processing, biological neural network.

**Artificial Neural Networks:** introduction, historical notes, neuron model, knowledge representation, comparison with biological neural network, applications.

**Learning process:** Supervised learning, unsupervised learning, Error correction learning, competitive learning, adaptation learning, statistical nature of the learning process.

**UNIT-II**

**Basic Models:** McCulloch-Pitts neuron model, Hebb net, activation functions, aggregation functions.

**Perceptron networks:** perceptron learning, single layer perceptron networks, multilayer perceptron networks. Least mean square algorithm, gradient descent rule, nonlinearly separable problems and bench mark problems in NN.

**UNIT-III**

**Multilayer Neural network:** introduction, comparison with single layer networks.

**Back propagation network**: architecture, back propagation algorithm, local minima and global minima, heuristics for making back propagation algorithm performs better, applications.

**Radial basis function network**: architecture, training algorithm, approximation properties of RBF networks, comparison of radial basis function network and back propagation networks.

**UNIT-IV**

**Recurrent network**: introduction, architecture and types.

**Self-organizing feature map**: introduction, determining winner, Kohonen Self Organizing feature maps (SOM) architecture, SOM algorithm, properties of feature map; Learning vector quantization-architecture and algorithm. Principal component and Independent component analysis.

**UNIT-V**

**Special networks:** Cognitron, Support vector machines. Complex valued NN and complex valued BP.

**Soft computing:** Introduction, Overview of techniques, Hybrid soft computing techniques.

***References:***


1. Kumar S., "Neural Networks- A Classroom Approach", Tata McGraw Hill.
2. Haykin S., "Neural Networks – A Comprehensive Foundation", Pearson Education.
3. Yegnanarayana B. "Artificial Neural Networks", Prentice Hall of India.
4. Freeman J. A., "Neural Networks", Pearson Education.
5. James F., "Neural Networks – Algorithms, Applications and Programming Techniques", Pearson Education.

# RCAI025: BIG DATA

**UNIT-I**

**Understanding big data:** What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data ,credit risk management, big data and algorithmic trading, big data and HealthCare, big data in medicine, advertising and big data, big data technologies, Introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing Analytics, inter and trans firewall analytics.

**UNIT-II**

**NoSQL data management:** Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharing, masters slave replication, peer-peer replication, sharing and replication, consistency, relaxing consistency, version stamps, map reduce, partitioning and combining, composing map-reduce calculations.

**UNIT-III**

**Basics of Hadoop:** Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, oppression, serialization, Avro file-based data structures.

**UNIT-IV**

**Map reduce applications:** Map Reduce workflows, UNIT tests with MR UNIT, Test data and local tests – anatomy of Map Reduce job run, Classic Map-reduce, YARN, Failures in classic Map-reduce and YARN, Job scheduling, Shuffle and sort, Task execution, MapReduce types, Input formats, Output formats.

**UNIT-V**

**Hadoop related tools:** HBase, data model and implementations, Hbase clients, Hbase examples – praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients , Hadoop integration, Pig, Grunt, Pig data model, Pig Latin, Developing and testing Pig Latin scripts, Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

***References :***


1. Minelli M., Chambers M. and Dhiraj A., “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley, 2013.
2. Sadalage P. J. and Fowler M., “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley Professional, 2012.
3. White T., “Hadoop: The Definitive Guide”, Third Edition, O'Reilley, 2012.
4. Jain V.K., “Big Data & Hadoop”, Khanna Publishing House.
5. Sammer E., “Hadoop Operations”, O'Reilley, 2012.
6. Capriolo E., Wampler D. and Rutherglen J., “Programming Hive”, O'Reilley, 2012.
7. George L., “HBase: The Definitive Guide”, O'Reilley, 2011.
8. Hewitt E., “Cassandra: The Definitive Guide”, O'Reilley, 2010.
9. Gates A., “Programming Pig”, O'Reilley, 2011.

# ELECTIVE-3

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# RCAI031: CLOUD COMPUTING

**UNIT-I**

**Introduction of Cloud : D**efinition, benefits, usage scenarios, History of Cloud Computing, Cloud Architecture, Types of Clouds, Business models around Clouds, Major Players in Cloud Computing, Issues in Clouds, Eucalyptus, Nimbus, Open Nebula, CloudSim.

**UNIT-II**

**Cloud Services:** Types of Cloud services- Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

**UNIT-III**

**Collaborating Using Cloud Services:** Email Communication over the Cloud, CRM Management, Project Management, Event Management, Task Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks and Groupware.

**UNIT-IV**

**Virtualization for Cloud :** Need for Virtualization, Pros and cons of Virtualization, Types of Virtualization, System VM, Process VM, Virtual Machine monitor, Virtual machine properties, Interpretation and binary translation, HLL VM, supervisors, Xen, KVM, VMware, Virtual Box, Hyper-V.

**UNIT-V**

**Security Standards and Applications:** Security in Clouds- Cloud security challenges, Software as a Service Security, Common Standards- The Open Cloud Consortium, The Distributed management Task Force, Standards for application Developers, Standards for Messaging, Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

***References :***


1. David E.Y., “Implementing and Developing Cloud Application", CRC press 2011.
2. Badger L., Grance T., Patt-Corner R. and Voas J., “NIST, Draft cloud computing synopsis and recommendation”, May 2011.
3. Velte A.T., Velte T.J. and Elsenpeter R., "Cloud Computing : A Practical Approach", Tata McGraw-Hill 2010.
4. Beard H., "Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008.
5. Popek G. J. and Goldberg R.P., "Formal requirements for virtualizable third generation Architectures", Communications of the ACM, No.7 Vol.17, July 1974.
6. Rittinghouse J. and Ransome J., "Cloud Computing, Implementation, Management and Strategy", CRC Press, 2010.
7. Miller M., "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate", Que Publishing, August 2008.
8. Smith J.E. and Nair R., "Virtual Machines", Morgan Kaufmann Publishers, 2006.
9. Buyya R., “Mastering Cloud Computing” McGraw Hill Education.
10. Buyya R., “Cloud Computing Principles and Paradigms”, Wiley.
11. Jayawal K., “Cloud Computing Black Book”, Dreamtech.

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# RCAI032: SOFT COMPUTING

**UNIT-I**

**Introduction to Soft Computing:** Introduction, Comparison with hard computing, Concept of learning and adaptation, Constituents of soft computing, Applications of soft computing.

**Artificial Neural Networks:** Basic concepts of neural networks, Human brain, Biological neural network, History of artificial neural networks, Basic building blocks of an artificial neuron, Neural network architectures, Activation functions.

**UNIT-II**

**Artificial Neural Networks:** Learning methods - Supervised, Unsupervised, Reinforcement, Hebbian, Gradient descent, Competitive, Stochastic.

**Major classes of neural networks:** Perceptron networks, Multilayer perceptron model, Back-propagation network, Radial basis function network, Hopfield networks, Kohonen self-organizing feature maps.

**UNIT-III**

**Fuzzy Logic:** Introduction to Fuzzy Logic, Comparison with crisp logic, Properties of classical sets, Operations on classical sets, Properties of fuzzy sets, Operations on fuzzy sets, Classical relations, Fuzzy relations, Features and types of fuzzy membership functions, Fuzzy arithmetic, Fuzzy measures.

**Fuzzy Systems:** Crisp logic, Predicate logic, Fuzzy logic, Fuzzy propositions, Inference rules, Fuzzy inference systems, Types of inference engines.

**UNIT-IV**

**Evolutionary Computing:** Introduction, Evolutionary algorithm, Biological evolutionary process, Paradigms of evolutionary computing – Genetic algorithm and Genetic programming, Evolutionary strategies, Evolutionary programming.

**Genetic Algorithm:** Introduction, Traditional optimization and search techniques, Comparison with traditional algorithms, Operations- Encoding, Selection, Crossover and Mutation.

**UNIT-V**

**Hybrid Soft Computing Techniques:** Introduction, Classification of hybrid systems, Neuro-fuzzy hybrid systems, Neuro-genetic hybrid systems, Fuzzy-genetic hybrid systems.

**Other Soft Computing Techniques:** Tabu Search, Ant colony based optimization, Swarm Intelligence.

***References:***


1. Sivanandam S.N. and Deepa S.N., "Principles of Soft Computing", Wiley-India.
2. Rajasekaran S. and Vijayalakshmi Pai G.A., "Neural Networks, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications", PHI Learning.
3. Kaushik S. and Tiwari S., "Soft Computing – Fundamentals, Techniques and Applications', McGrawHill Education.
4. Jang J.-S.R., Sun C.-T. and Mizutani E., "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India.
5. Karray F. O. and Silva C. D., "Soft Computing and Intelligent Systems Design – Theory, Tools and Applications", Pearson Education.
6. Hassoun H. M., "Fundamental of Artificial Neural Networks", Prentice-Hall of India.
7. Freeman J. A. and Skapura D. M., "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson.

# RCAI033: DEEP LEARNING

**UNIT-I**

**Machine Learning**- Introduction, Types, Linear models, Introduction of Neural Network, Training a neural network, Activation functions, Loss functions, Hyper parameters, Neural networks as universal function approximates, Road to deep learning.

**UNIT-II**

**Deep Networks** : Introduction and history of deep learning, Probabilistic theory of deep learning, Common architectural principles of deep networks, Building blocks of deep networks, Comparison with shallow networks, Deep belief networks, Generative Adversarial Networks (GAN), Semi-supervised Learning.

**UNIT-III**

**Convolutional Neural Networks:** From fully connected network to convolutions, Common convolutional architectural patterns, Configuring convolutional layers, Configuring pooling layers, Transfer learning, Convolutional neural network – LeNet, AlexNet, VGG, NiN, GoogLeNet, Batch normaization, ResNet, DenseNet.

**UNIT-IV**

**Recurrent Neural Networks :** Sequence models, Language models, Implementation of recurrent neural networks, GRU, LSTM, Deep recurrent neural networks, Bidirectional recurrent neural networks, Machine translation, Encoder-decoder architecture, Sequence to sequence.

**UNIT-V**

**Optimization:** Optimization in deep learning, Convexity, Gradient descent, Stochastic gradient descent.

**Applications:** Speech and audio processing, Natural language processing, Information retrieval, Object recognition and computer vision.

***References:***

1. Goodfellow I., Bengio Y. and Courville A., “Deep Learning”, MIT Press.
2. Shalizi C. R., “Advanced Data Analysis from an Elementary Point of View”, Cambridge University Press.
3. Deng L. and Yu D., “Deep Learning- Methods and Applications”, Now Publishers.
4. Nielsen M., “Neural Networks and Deep Learning”, Determination Press.
5. Patterson J. and Gibson A., “Deep Learning – A Practitioner’s Approach”, O’Reilly.

# RCAI034: DISTRIBUTED SYSTEMS

**UNIT-I**

**Distributed Systems:** Introduction, Characteristics, Examples of distributed Systems, Resource sharing and Web Challenges. Architectural models, Fundamental Models.

**Theoretical Foundation for Distributed Systems:** Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks.

**Concepts in Message Passing Systems:** Causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and 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**

**Agreement Protocols:** Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system.

**Distributed Resource Management:** Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.

**UNIT-IV**

**Failure Recovery in Distributed Systems:** Concepts in Backward and Forward recovery, Recovery in Concurrent systems, obtaining consistent Checkpoints, Recovery in Distributed Database Systems.

**Fault Tolerance:** Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols.

**UNIT-V**

**Transactions and Concurrency Control:** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

**Distributed Transactions:** Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

***References:***


1. Singhal and Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill.
2. Ramakrishna and Gehrke, "Database Management Systems", McGraw Hill.
3. Garg V. K., "Elements of Distributed Computing", Wiley.
4. Coulouris, Dollimore and Kindberg, "Distributed System: Concepts and Design", Pearson Education.
5. Tanenbaum A. S. and Steen M. V., "Distributed Systems: Principles and Practices", Pearson Education.

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# RCAI035: ADVANCED DATABASE MANAGEMENT SYSTEMS

**UNIT-I**

**Query Processing and Optimization:** Valuation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.

**UNIT-II**

**Objected Oriented and Object Relational Databases :** Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases

**UNIT-III**

**Parallel and Distributed Databases:** Distributed Data Storage – Fragmentation & Replication, Location and Fragment Transparency Distributed Query Processing and Optimization, Distributed Transaction Modeling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.

**UNIT-IV**

**Advanced Transaction Processing:** Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors.

**UNIT-V**

Multimedia Databases, Databases on the Web and Semi–Structured Data. Case Study- Oracle Xi.

***References*:**


1. Navathe E. and Gupta S., "Fundamentals of Database Systems", 4th Edition, Pearson Education, 2007.
2. Garcia, Ullman, Widom, "Database Systems, The complete book", Pearson Education, 2007.
3. Ramakrishnan R., "Database Management Systems", McGraw Hill International Editions, 1998.
4. Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8th Edition Pearson Education, 2007.
5. Singh S.K., "Database System Concepts, design and application", Pearson Education, 2006.
6. Silberscatz, Korth and Sudarshan, "Database System Concepts", Mcgraw Hill, 6th Edition, 2006.
7. Kim W., "Modern Database Systems", 1995, ACM Press, Addision – Wesley.
8. Maier D., "The Theory of Relational Databases", Computer Science Press, Rokville, 1993, Maryland.
9. Ullman J. D., "Principals of database systems", Galgotia Publications, 1999.
10. Oracle Xi Reference Manual.
11. Dietrich and Urban, "An Advanced Course in Database Systems", Pearson, 2008.

# ELECTIVE-4

# RCAI041 DISTRIBUTED DATABASE SYSTEMS

**UNIT-I**
Transaction and schedules, Concurrent Execution of transaction, Conflict and View Serializability, Testing for Serializability, Concepts in Recoverable and Cascade less schedules.

**UNIT–II**
Lock based protocols, time stamp-based protocols, Multiple Granularity and Multi version Techniques, enforcing serializability by Locks, Locking system with multiple lock modes, architecture for Locking scheduler

**UNIT-III**
Distributed Transactions Management, Data Distribution, Fragmentation and Replication Techniques, Distributed Commit, Distributed Locking schemes, Long duration transactions, Moss Concurrency protocol.

**UNIT–IV**
Issues of Recovery and atomicity in Distributed Databases, Traditional recovery techniques, Log based recovery, Recovery with Concurrent Transactions, Recovery in Message passing systems, Checkpoints, Algorithms for recovery line, Concepts in Orphan and Inconsistent Messages.

**UNIT-V**
Distributed Query Processing, Multiway Joins, Semi joins, Cost based query optimization for distributed database, Updating replicated data, protocols for Distributed Deadlock Detection, Eager and Lazy Replication Techniques.

***References :***

1. Silberschatz, Korth and Sudershan, "Database System Concept", McGraw Hill.
2. Ramakrishna and Gehrke,"Database Management System", McGraw Hill.
3. Garcia-Molina, Ullman and Widom,"Database System Implementation", Pearson Education.
4. Ceei and Pelagatti,"Distributed Database", TMH.
5. Trivedi M.C., "Distributed System", Khanna Publishing House.
6. Singhal and Shivratri, "Advance Concepts in Operating Systems", McGraw Hill.

**MASTER OF COMPUTER APPLICATION (INTEGRATED)**

# RCAI042: SIMULATION AND MODELING

**UNIT-I**

System definition and components, stochastic activities, continuous and discrete systems, System modeling. Types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study.

**UNIT-II**

System simulation, Need of simulation, Basic nature of simulation, techniques of simulation, comparison of simulation and analytical methods, types of system Simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag model, Cobweb model.

**UNIT-III**

Simulation of continuous Systems, analog vs digital simulation, simulation of water reservoir system, simulation of a servo system, simulation of an auto-pilot. Discrete system simulation, fixed timestep vs event-to-event model, generation of random numbers, test of randomness, Monte-Carlo computation vs stochastic simulation.

**UNIT-IV**

System dynamics, exponential growth models, exponential decay models, logistic curves, system dynamics diagrams, world model.

**UNIT-V**

Simulation of PERT networks, critical path computation, uncertainty in activity duration, resource allocation and consideration, Simulation languages, object oriented simulation.

***References:***


1. Gordon G., "System Simulation", Prentice Hall of India.
2. Deo N., "System Simulation with Digital Computer", Prentice Hall of India.
3. Law A. M. and Kelton W. D., "Simulation Modeling and Analysis", Tata McGraw Hill.
4. Zeigler B. P., Praehofer H. and Kim T. G., "Theory of Modeling and simulation Integrating Discrete Event and Continuous Complex Dynamic Systems", Academic Press.
5. Severance Frank L., "System Modeling and Simulation - An Introduction", John Wiley & Sons.
6. Banks J., Carson J. S., Nelson and Nicol, "Discrete –Event system Simulation", Prentice-Hall of India.

# RCAI043: INTRODUCTION TO MACHINE LEARNING

**UNIT-I**

**Overview and Introduction to Machine Learning:** Data Science, AI & ML , Introduction of Machine intelligence and its applications, Machine learning concepts, Components of a learning problem, supervised, unsupervised and reinforcement learning, inductive learning, deductive learning.

**UNIT-II**

**Foundations of Machine Learning:** Hypothesis Space and Inductive Bias, feature selection. Classification, regression linear and polynomial, logistic regression, decision tree, random forest, naïve bayes, SVM.

**UNIT-III:**

**Clustering and Dimensionality Reduction:** Adaptive hierarchical clustering, SVD PCA, K-means, Association analysis, Hidden Markov model.

**UNIT-IV:**

**Reinforcement Learning:** Elements of Reinforcement Learning, Characteristics of reinforcement learning, various techniques used in reinforcement, Model-Based Learning, Temporal Difference Learning, Markov decision process, Deep Learning.

**UNIT-V:**

**Learning with Neural Networks:** Introduction to Artificial Neuron, Architectures, Learning Methods, Taxonomy of NN Systems, Single-Layer NN System, Applications. Back Propagation Network- Background, Back-Propagation Learning, Back-Propagation Algorithm.

***References:***

1. Alpaydin E., “Introduction to Machine Learning”, Prentice Hall of India.
2. Mitchell T.M., “Machine Learning”, McGraw-Hill Education (India) Private Limited.
3. Marsland S., “Machine Learning - An Algorithmic Perspective”, CRC Press.
4. Bishop C., “Pattern Recognition and Machine Learning”, Berlin: Springer-Verlag.

# RCAI044: PATTERN RECOGNITION

**UNIT-I**

**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, Multivariate normal densities, Chi square test.

**UNIT-II**

**Statistical Patten Recognition:** Bayesian Decision Theory, Classifiers, Normal density and discriminant functions.

**UNIT-III**

**Parameter Estimation Methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

**UNIT-IV**

**Nonparametric Techniques:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

**UNIT-V**

**Unsupervised Learning and Clustering:** Criterion functions for clustering, Clustering Techniques - Iterative square, Error partitional clustering, K means, Agglomerative hierarchical clustering, Cluster validation.

***References*:**

1. Duda R. O., Hart P. E. and Stork D. G., “Pattern Classification”, John Wiley.
2. Bishop C. M., “Neural Network for Pattern Recognition”, Oxford University Press.
3. Singhal R., “Pattern Recognition: Technologies & Applications”, Oxford University Press.
4. Theodoridis S. and Koutroumbas K., “Pattern Recognition”, Academic Press.

**MASTER OF COMPUTER APPLICATION (INTEGRATED)**

# RCAI045: ANDROID OPERATING SYSTEM

**UNIT-I**

**Android Architecture**: Introduction to Android, Layouts, Views and Resources, Activities and Intents , Activity Lifecycle and Saving State, Activities and Implicit Intents, Testing & Debugging App , Android Support Libraries

**UNIT-II**

**User Interaction and Intuitive Navigation:** Input Controls, Menus, Widgets, Screen Navigation, Recycler View, ListView, Adapters and Data Binding, Drawables, Themes and Styles

**UNIT-III**

**Background Tasks**: AsyncTask and AsyncTask Loader, Broadcast receivers, Services, Notifications, Alarm managers, Date transferring, Internet access,

**UNIT-IV**

**Storing, Sharing and Retrieving Data in Android Applications:** Overview to storing data, Shared preferences, App settings, Store and query data in Android's SQLite database. Content Providers, Content Resolver, Loading data using loaders.

**UNIT-V**

**Permissions, Performance and Security**: Firebase and AdMob, Publish your app, Packaging and deployment, Interaction with server side applications – Using Google Maps, GPS and Wi-Fi, HTML and XML Parsing.

***References***:


1. Meier R., "Professional Android 2 Application Development", Wiley.
2. Hashimi S., Komatineni S. and MacLean D., "Pro Android 2", Apress.
3. Murphy M., "Beginning Android 2", Apress.
4. Delessio C. and Darcey L., "Android Application Development", Pearson Education.
5. DiMarzio J. F., "Android a Programming Guide", Tata McGraw Hill.

# RCAI951: COMPUTER GRAPHICS LAB

1. Write a program to draw line by using DDA algorithm.
2. Write a program to draw line by using Bresenham's algorithm.
3. Write a program to draw a circle using midpoint circle algorithm.
4. Write a program of Cohen-Sutherland algorithm.
5. Write a program to shear a cuboid.
6. Write a program to draw a polygon and perform rotation operation.
7. Write a program to draw a polygon and perform translation operation.
8. Write a program to draw a polygon and perform scaling operation.
9. Write a program to draw a rectangle by using Bresenham's algorithm.
10. Write a program to draw a rectangle by using DDA algorithm.
11. Write a program to translate a line by using DDA algorithm.
12. Write a program to rotate a triangle.
13. Write a program to convert window coordinates in to view port.
14. Write a program of Liang-Barksy algorithm.
15. Write a program to perform 3d rotation operation.
16. Write a program to perform 3d translation operation.
17. Write a program to perform 3d scaling operation.
18. Write a program to draw a fish.
19. Write a program to draw a kite.
20. Write a program to draw a hut.

*Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.*

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## RCAI952 : Project Based on Software Engineering

Students are expected to analyze the problem statement/ case study and design a solution applying software engineering principles.