JECRC™ UNIVERSITY

BUILD YOUR WORLD

# School of Engineering

# Syllabi and Course Structure

## M. Tech. in Computer Science and Engineering

## (2025-2027)

## Academic Programmes
## July,2025

| *MCO145A* | **Mastering Algorithms: From Logic to Code** | **3-0-0** |
|---|---|---|

**Course Objectives:**
The course aims to:

1. Strengthen foundational knowledge in algorithm design and analysis.
2. Introduce advanced techniques for optimization and problem solving.
3. Explore the theoretical limits of algorithmic computation.
4. Develop students' ability to solve real-world and research-oriented problems.
5. Build proficiency in coding complex algorithms with performance awareness.

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| **UNIT 1** | **Algorithm Analysis and Recurrences** Review of asymptotic notations: Big-O, Omega, Theta, Solving recurrences: Substitution method, Recursion tree, Master theorem **Randomized Algorithms and Hashing:** Las Vegas vs Monte Carlo algorithms , Randomized Quicksort, Reservoir sampling , Hashing: Universal hashing, probabilistic guarantees , Probabilistic analysis and expected runtime calculations |
| **UNIT 2** | **Advanced Graph Algorithms :** Graph traversal recap: DFS, BFS, articulation points, bridges , Advanced shortest paths: Dijkstra with heaps, Johnson's algorithm , Maximum flow algorithms: Ford-Fulkerson, Edmonds-Karp , Bipartite matching and network flow applications |
| **UNIT 3** | **Advanced Dynamic Programming and Optimization Techniques:** Memory optimization techniques and state space compression, Bitmask DP, DP with Knuth/Yao optimization, DP on trees and graphs , Approximation algorithms: Vertex cover, Traveling Salesman Problem (TSP) |
| **UNIT 4** | **Computational Geometry & Number Theory Algorithms :** Convex Hull (Graham Scan), line intersection, sweep line algorithms ,Euclidean GCD, modular arithmetic fundamentals , Sieve of Eratosthenes for primes , Fast exponentiation, modular inverse, introduction to RSA |
| **UNIT 5** | **Computational Complexity :** Complexity classes: P, NP, NP-Complete, NP-Hard , Polynomial time reductions , Overview of Cook-Levin theorem , Classic NP-complete problems: SAT, 3-SAT, vertex cover |

**Course Outcomes:**
After successful completion of this course, students will be able to:
**CO1** – Understand and analyse the theoretical foundations of algorithms including complexity classes.

**CO2** – Develop algorithmic strategies using advanced techniques like dynamic programming, greedy methods, and divide & conquer.

**CO3** – Apply probabilistic, approximation, and randomized methods to design algorithms for computationally hard problems.

**CO4** – Explore specialized domains such as graph algorithms, geometry, and number theory with algorithmic perspectives.

**CO5** – Translate algorithmic concepts into efficient, optimized code and evaluate performance on real-world datasets or simulations.

**Textbooks & References:**

1. **"Introduction to Algorithms"** – Cormen et al.
2. **"Algorithm Design"** – Jon Kleinberg and Éva Tardos
3. **"The Algorithm Design Manual"** – Steven S. Skiena
4. **Online Resources:** MIT OpenCourseWare, GeeksforGeeks, CP-Algorithms.

**Programming Language:** C++ / Python (student choice)

**Platforms:** LeetCode, HackerRank, Codeforces (for practice)

**Tools:** Git, Visual Studio Code, Jupyter Notebooks

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
| CO1 | | H | | L | H | L | H | | L | | | | | H | |
| CO2 | | | L | | M | | L | | M | H | | L | | H | |
| CO3 | | M | | | | | | | | L | | M | | | M |
| CO4 | | | | | H | | | | | | | | H | | |
| CO5 | | | H | | | | M | | | | | | H | | |

H = Highly Related; M = Medium L = Low

**M.Tech. in Computer Science & Engineering Semester I**

| MCO146A | DISTRIBUTED SYSTEMS | **Total Credits: 3** |
|---|---|---|

**Course Objectives:**

1.Understand the basic concepts and models of distributed systems including architecture, goals, and types.

2. Analyze communication mechanisms, including Remote Procedure Calls (RPC), RMI, and message-passing models.

3. Evaluate synchronization, consistency models, and fault tolerance techniques in distributed environments.

4. Design and implement distributed algorithms such as mutual exclusion, leader election, and consensus.

5. Examine and apply concepts of distributed file systems, distributed databases, and big data frameworks like Hadoop, GFS, or Spark.

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| **UNIT 1** | **Basic Concepts**: Definition of a distributed systems, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking Interprocess communication, External data representation and marshalling, Client-server and Group communication. |
| **UNIT 2** | **Distributed Objects and Process:** Distributed objects and remote invocation, Communication between distributed objects, Remote procedure call, Events and notifications - The operating system layer, Protection, Processes and Threads, Communication and invocation, OS Architecture. Security techniques, Cryptographic algorithms, Access control, Digital signatures, Cryptography pragmatics, Needham-Schroeder, Kerberos, Securing electronics transaction, IEEE 802.11 WiFi. |
| **UNIT 3** | **Operating System Issues:** Distributed file systems - Name services, Domain name system, Directory and discovery services, Peer to peer systems, Napster file sharing system, Peer to peer middleware routing overlays – Clocks, Events and process states Clock Synchronization - Logical clocks Global states - Distributed debugging - Distributed mutual exclusion - Elections - Multicast communication. |
| **UNIT 4** | **Distributed Transaction Processing:** Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery - Overview of replication, Distributed shared memory and Web services. |
| **UNIT 5** | **Distributed Algorithms** Synchronous network model - Algorithms: leader election, maximal independent set. Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous |

| | |
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| | network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network. |

**Course Outcomes:**

After successful completion of this course, students will be able to:

1. **Understand** the architecture, models, and key principles of distributed systems.
2. **Analyze** various inter-process communication and coordination mechanisms in distributed environments.
3. **Apply** synchronization, naming, and mutual exclusion algorithms in distributed applications.
4. **Evaluate** replication strategies, consistency models, and fault tolerance techniques.
5. **Design** and work with distributed file systems, databases, and real-world platforms like Hadoop and blockchain.

**Textbooks & References**


1. Tanenbaum & Van Steen, Distributed Systems: Principles and Paradigms, Pearson
2. Coulouris et al., Distributed Systems: Concepts and Design, Pearson
3. S. Ghosh, Distributed Systems: An Algorithmic Approach, CRC Press
4. Research Papers and whitepapers (Google Spanner, Amazon DynamoDB, etc.)


**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
| CO1 | | H | | L | H | L | H | | L | | | | | H | |
| CO2 | | | L | | M | | L | | M | H | | L | | H | |
| CO3 | | M | | | | | | | | L | | M | | | M |
| CO4 | | | | | H | | | | | | | | H | | |
| CO5 | | | H | | | | M | | | | | | H | | |

H = Highly Related; M = Medium  L = L

| MCO147A | Mastering Algorithm:Logic to CodeLab | 0-0-2 |
|---|---|---|

***List of Experiments***

*1. Write a Program to implement Efficient Matrix Multiplication*

*2. Write a Program to define the graphs and list all nodes and Links*

*3. Write a Program to implement the concept of BFS*

*4. Write a Program to implement the concept of DFS*

*5. Write a Program to implement the concept of B-tree*

*6. Write a Program to implement Dijkistra Algorithm*

*7. Write a Program to implement the concept of Binomial Heap*

*8. Write a program to find Greatest Common Divisor*

*9. Write a program using Chinese remainder theorem*

*10 Write program to solve linear equations*

*11 Write a program to solve Travelling Salesman problem*

*12 Write a program to implement Vertex cover problem*

*13 Write a program to implement all pair shortest path Algorithm*

***M. Tech. (common to all disciplines)-I Semester***
***Contact Hours (L-T-P): 0-0-2***

| **MCO148A** | **Simulation Lab** | **Total Credits: 1** |
|---|---|---|

*List of Experiments (Sample)*

*These may vary depending on the domain (CS, AI, etc.)*

*1. Introduction to simulation tools (e.g., MATLAB/Simulink, Arena, OMNeT++, NS2, AnyLogic).*

*2. Random number generation and testing (using Linear Congruential Generator, etc.).*

*3.Simulating Queueing systems (Single/Multi-server queues – M/M/1, M/M/c).*

*4.Simulation of Inventory Systems (EOQ, JIT models).*

*5.Simulation of a Bank / ATM system.*

*6.Simulation of a Traffic Light system.*

*7.Network & Communication Systems*

*8.Simulation of Packet Transmission over a Network (using NS2/NS3/OMNeT++).*

*9.Simulation of a Communication Protocol (e.g., ALOHA, CSMA/CD).*

| DMA017A | Research Methodology | 2-0-0 |
|---|---|---|

***Course Objectives***

1. To understand basic concepts of research and its methodologies
2. To Identify appropriate research topics
3. To Select and define appropriate research problem and parameters
4. To understand hypothesis formulation and testing
5. To learn fundamentals of thesis writing

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|---|---|
| UNIT 1 | **Research Fundamentals and Terminology:**Importance of Research in Management Decisions, Objectives of Research, Types of Research, Research Process, Defining Research Problems. Census and Sample Survey. |
| UNIT 2 | **Research Design:** Type of Research Design, Natural Experiments, Formal Type of Experiments, Evaluation of Experiments, Selecting Relevant Variables, Validity of Experiments. Sample design, Steps in sample design, Criteria for selection of sample, Different types of sample design, The Sampling Process |
| UNIT 3 | **Data Analysis :** Methods and Techniques of Data Collection Type of Data , Distinction between primary Data and Secondary, Data Collection Procedure for rimary Data, Data preparation and Preliminary Analysis, Presentation of Data, Oral Presentation<br>Statistical Analysis: Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), and Interpretation of Data, Linear Correlation and Linear Regression. |
| UNIT 4 | **Hypothesis Testing**: Null and alternative hypothesis, Level of significance, Type I and type II error, Two-tailed and one-tailed tests, Procedure of hypothesis testing, Power of hypothesis test,Hypothesis Testing: t test, Chi-square test and F test. |
| UINT 5 | **Report writing and Presentation:**Fundamental of Report Writing and Formatting of Reports ,Additional Statistics in Research |

**Course Outcome :**

1. Student will able to understand basic concepts of various research areas
2. Student will able to identify appropriate research topics concerned to Engineering field
3. Student will select and define appropriate research problem and its related parameters
4. Student will able to prepare the hypothesis and testing of hypothesis.
5. Student will able to develop skill of thesis /Dissertation writing .

**Text Books**


1. Bhattacharya K. Dipak, Research Methodolgy , , Excel Books , New Delhi
2. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006Ranjit Kumar, Research Methodology- A Step-By-Step Guide for Beginners,(Pearson Education, Delhi) endat and Piersol, Random data: Analysis and Measurement Procedures, Wiley Interscience, 2001


***References***


1. Montgomery, Douglas C. &Runger, George C. (2007) – Applied Statistics & Probability

2. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi)
3. Richard I Levin amp; David S. Rubin, Statistics for Management, 7/e. Pearson Education, 2005
4. Krishnaswamy, K. N., Sivakumar, Appa Iyer and Mathirajan, M. (2006), anagement Research Methodology: Integration of Principles, Methods and echniques (Pearson Education, New Delhi) Montgomery, Douglas C. (2007) – Design Analysis of Experiments, 5/e. (New Delhi) Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006

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**M.Tech. in Computer cience & Engineering  Semester I**

| DMA018B | **Quantitative Technique Lab** | **0-0-2** |
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1. Computation of Quartile deviation.
2. Computation of Variance.
3. Computation of Coefficient of Variation.
4. To check the symmetry of the distribution by coefficient of Skewness.
5. To check the Shape of the distribution by coefficient of Kurtosis.
6. Solve the problems of Linear Correlation and Regression.
7. To test the hypothesis for Testing Single Mean Problem by t test.
8. To test the hypothesis for Testing Two Mean Problem by t test.
9. To test the hypothesis for Testing Significance of Correlation Coefficient by t test.
10. To test the hypothesis for testing Single Variance by Chi-Square test.
11. To test the hypothesis for testing Goodness of fit by Chi-Square test.
12. To test the hypothesis for testing Independence of Attributes. by Chi-Square.
13. To test the hypothesis for testing Two Variance by F test.
14. Computations with one way analysis
15. Computations with Two way analysis

| MCO149A | Computational Methods Lab Using MATLAB | 0-0-2 |
|---|---|---|

**Course Objectives:**

1. Introduce the fundamentals of MATLAB programming.
2. Enable students to implement numerical methods.
3. Develop practical understanding of solving ordinary differential equations (ODEs).
4. Bridge the gap between mathematical theory and practical implementation.
5. Enhance problem-solving and analytical skills.

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| **UNIT 1** | . Introduction to MATLAB<br>The MATLAB Environment<br>• MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output.<br>• Vectors, Arrays – Matrices |
| **UNIT 2** | MATLAB Functions<br>• Built-in Functions<br>• User defined Functions |
| **UNIT 3** | Graphics with MATLAB<br>• Files and File Management – Import/Export<br>• Basic 2D, 3D plots<br>• Graphic handling |
| **UNIT 4** | Programming with MATLAB<br>• Conditional Statements, Loops<br>• MATLAB Programs – Programming and Debugging.<br>• Applications of MATLAB Programming. |
| **UNIT 5** | Mathematical Computing with MATLAB<br>• Algebraic equations<br>• Basic Symbolic Calculus and Differential equations<br>• Numerical Techniques and Transforms |

**Course Outcomes**

Upon successful completion of this course, the student will be able to:

**CO1:** Develop and execute MATLAB programs to solve computational and mathematical problems.

**CO2:** Apply numerical methods such as root-finding, interpolation, differentiation, and integration using MATLAB.

**CO3:** Solve linear and nonlinear equations, and ordinary differential equations (ODEs) using MATLAB tools.

**CO4:** Analyze and visualize computational results using appropriate MATLAB plotting and graphing techniques.

**CO5:** Design and implement algorithmic solutions for real-world problems through simulation in MATLAB.

**Suggested Books**

1. “A Guide to MATLAB - for Beginners and Experienced Users”, 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).
2.Essentials of MATLAB Programming”, 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
3. MATLAB Demystified”, David McMahon, The McGraw-Hill Companies, (2007).
4. “MATLAB® for Engineers”, 3rd Ed., Holly Moore, Pearson Education, Inc., (2012)
5. “Engineering computation with MATLAB”, 2nd Ed., David M. Smith, Pearson Education, Inc., (2010). Dr. Deepak R. Patil Co-ordinator Dr. T. S. Salve

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | H | | L | H | L | H | | L | | | | | H | |
| CO2 | | | L | | M | | L | | M | H | | L | | H | |
| CO3 | | M | | | | | | | | L | | M | | | M |
| CO4 | | | | | H | | | | | | | | H | | |
| CO5 | | | H | | | | M | | | | | | H | | |

H = Highly Related; M = Medium L = Low

| MCO150A | COGNITIVE SCIENCE | 3-0-0 |
|---|---|---|

***Course Objectives:***

1. To introduce the interdisciplinary foundations of cognitive science.
2. To understand key cognitive processes**.**
3. To explore cognitive models and architectures.
4. To apply computational methods for modelling cognitive functions
5. To analyze the relationship between language, thought, and the brain.

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| ***UNIT 1*** | **INTRODUCTION TO COGNITIVE SCIENCE AND COGNITIVE COMPUTING WITH AI:** Cognitive Computing, Cognitive Psychology, The Architecture of the Mind, The Nature of Cognitive Psychology, Cognitive architecture, Cognitive processes, The Cognitive Modeling Paradigms, Declarative / Logic based Computational cognitive modeling, connectionist models –Bayesian models. Introduction to Knowledge-Based AI – Human Cognition on AI – Cognitive Architectures |
| ***UNIT 2*** | **COGNITIVE COMPUTING WITH INFERENCE AND DECISION SUPPORT SYSTEMS:** Intelligent Decision making, Fuzzy Cognitive Maps, learning algorithms: Nonlinear Hebbian Learning, Data driven NHL, Hybrid learning, Fuzzy Grey cognitive maps, Dynamic Random fuzzy cognitive Maps |
| ***UNIT 3*** | **COGNITIVE COMPUTING WITH MACHINE LEARNING:** Machine learning Techniques for cognitive decision making, Hypothesis Generation and Scoring, Natural Language Processing, Representing Knowledge, Taxonomies and Ontologies, N-Gram models, Application |
| ***UNIT 4*** | **Neural and Computational Models of Cognition**<br>• Basics of Neural Information Processing<br>• Connectionist models: Artificial Neural Networks<br>• Cognitive Neuroscience and Brain Imaging Techniques (EEG, fMRI)<br>• Modeling attention, memory, and decision making using neural networks<br>• Machine learning models inspired by cognition |
| ***UNIT 5*** | **CASE STUDIES:**Cognitive Systems in health care, Cognitive Assistant for visually impaired – AI for cancer detection, Predictive Analytics, Text Analytics, Image Analytics, Speech Analytics – IBM Watson – |

***<u>Course Outcomes</u>***

*Upon successful completion of this course, the student will be able to:*

***CO1:*** *Explain the foundational concepts of cognitive science and cognitive computing, including cognitive architectures and modeling paradigms.*

***CO2:*** *Apply fuzzy cognitive maps, Hebbian learning, and inference techniques in intelligent decision-making systems.*

***CO3:*** *Utilize machine learning and natural language processing methods for cognitive decision support and knowledge representation.*

***CO4:*** *Analyze neural and computational models of cognition using techniques such as neural networks and brain imaging data.*

***CO5:*** *Evaluate real-world applications of cognitive computing in domains like healthcare, predictive analytics, and AI systems such as IBM Watson.*

***Suggested Books***

1. *Cognitive Science: An Introduction to the Study of Mind* Authors: Jay Friedenberg & Gordon Silverman.
2. Mind: Introduction to Cognitive Science Author: Paul Thagard
3. *The MIT Encyclopedia of the Cognitive Sciences (MITECS)*
   Editors: Robert A. Wilson & Frank C. Keil
4. *Cognitive Psychology: A Student's Handbook*
   Authors: Michael W. Eysenck & Mark T. Keane
5. *How the Mind Works*
   Author: Steven Pinker

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| ***Course Outcome*** | ***Program Outcome*** | | | | | | | | | | | | ***Program Specific Outcome*** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO 1* | *PO 2* | *PO 3* | *PO 4* | *PO 5* | *PO 6* | *PO 7* | *PO 8* | *PO 9* | *PO 10* | *PO 11* | *PO 12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | | | *H* | *L* | *H* | *L* | *H* | | *L* | | | | | *H* | |
| *CO2* | | | *L* | | *M* | | *L* | | *M* | *H* | | *L* | | *H* | |
| *CO3* | | *M* | | | | | | | | *L* | | *M* | | | *M* |
| *CO4* | | | | | *H* | | | | | | | | *H* | | |
| *CO5* | | | *H* | | | | *M* | | | | | | *H* | | |

*H = Highly Related; M = Medium L = Low*

**M.Tech. in Computer Science & Engineering Semester II**

| MCO151A | **Big Data Analytics** | **3-0-0** |
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**CO1:** Understand the fundamental concepts of big data, its characteristics (volume, velocity, variety), and the challenges associated with it.
**CO2:** Apply Hadoop and MapReduce programming models for processing large-scale datasets.
**CO3:** Use tools and platforms like Hive, Pig, and Spark for querying and analyzing big data
**CO4:** Analyze various data storage models and NoSQL databases such as HBase, Cassandra, and MongoDB.
**CO5:** Develop big data applications to perform predictive analytics using machine learning algorithms and large datasets.

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| UNIT 1: | **Introduction**: 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 2: | Database Design: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map reduce calculations. |
| UNIT 3: | HDFS (Hadoop distributed file system): 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, compression, serialization, Avro, file-based data structures |
| UNIT 4: | Map Reduce: 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, Map Reduce types, input formats, output formats |
| UNIT 5: | Data Model and Implementations: HBase, data model and implementations, HBase clients, HBase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.<br>Overview of Pig and HiveQL: 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. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging*
*2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.*
*3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.*
*4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.*

*5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.*
*6. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.*
*7. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.*
*8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010. 9. Alan Gates, "Programming Pig", O'Reilley, 2011*

## Course Outcomes:

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | M | L | | | | | | | | H | M | | |
| CO2 | H | H | M | M | H | | | | M | | | H | H | H | |
| CO3 | H | H | H | H | H | | | | M | | H | H | H | H | |
| CO4 | H | M | M | L | | | | | | | | H | M | M | |
| CO5 | H | H | M | M | | | | | | | | H | M | M | |

H = Highly Related; M = Medium  L = Low

| MCO151A | **Introduction to blockchain and Cryptocurrency** | **3-0-0** |
|---|---|---|

**CO1:** Understand the foundational concepts of blockchain technology, including decentralized systems, distributed ledgers, and consensus mechanisms.
**CO2:** Explain the architecture and functioning of cryptocurrencies like Bitcoin and Ethereum, including wallets, mining, and smart contracts.
**CO3:** Analyze the role of cryptographic techniques such as hashing, digital signatures, and public-key infrastructure in blockchain security.
**CO4:** Evaluate blockchain applications beyond cryptocurrencies, such as supply chain, healthcare, and identity management.
**CO5:** Design and simulate basic blockchain-based applications or smart contracts using platforms like Ethereum and Solidity.

| | |
|---|---|
| UNIT 1: | Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain. |
| UNIT 2: | Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency |
| UNIT 3: | Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool. |
| UNIT 4: | Understanding Block chain for Enterprises Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, LamportShostak- ease BFT Algorithm, BFT over Asynchronous systems. |
| UNIT 5: | Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain. : Block chain application development: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, writing smart contract using Hyperledger Fabric, writing smart contract using Ethereum, Overview of Ripple and Corda. |

## M.Tech. in Computer Science & Engineering Semester II

| MCO153A | COMPUTER VISION | **3-0-0** |
|---|---|---|

***CO1:*** *Understand the fundamentals of computer vision and image processing.*

***CO2:*** *Apply various image processing techniques such as filtering, edge detection, and morphological operations.*

***CO3:*** *Analyze and implement feature detection, matching, and object recognition techniques.*

***CO4:*** *Design and implement algorithms for motion detection, tracking, and 3D reconstruction.*

***CO5:*** *Use modern tools and libraries (like OpenCV, TensorFlow, etc.) to build real-world computer vision applications.*

## Course Objective:

| | |
|---|---|
| **UNIT** 1: | *Overview: computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis* |
| **UNIT** 2: | *: Image Detection: Edge detection, Edge detection performance, Hough transform, corner detection* |
| **UNIT** 3: | *Segmentation, Morphological filtering, Fourier transform.* |
| **UNIT** 4: | *Image Features: Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre processing* |
| **UNIT** 5: | *Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods. Recent trends in Activity Recognition, computational photography, Biometrics.* |

## Text Books

*. 1. Computer Vision: Algorithms and Applications by Richard Szeliski.*

*2. Deep Learning, by Goodfellow, Bengio, and Courville.*

*3. Dictionary of Computer Vision and Image Processing, by Fisher et al*

*. 4. Computer Vision: Models, Learning, and Inference by Simon Prince*

*5. Computer Vision: A Modern Approach by David Forsyth and Jean Ponce*

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| Course Outcome | Program Outcome | | | | | | | | | | | | Program Specific Outcome | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | H | H | H | | | | | | | H | | | |
| CO2 | H | M | M | | | | | | | | | M | | | |
| CO3 | H | H | H | | | | | | | | | H | M | H | |
| CO4 | H | H | M | M | H | | | | | | | H | M | H | |
| CO5 | H | M | M | | | | | | | L | M | | M | H | |

H = Highly Related; M = Medium L = Low

| MCO149A | Data Analytics Lab | 0-0-2 |
|---|---|---|

The Laboratory shall have a multicore server running Hadoop or any similar platform. Alternatively, desktop with Multicore processor and 64/128GB RAM can be used to install Hadoop. R shall also be available in the Laboratory

Exercises: A. Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather or similar dataset. Dataset needs to be found and used. B. R/ Python
4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

| BCO154A | **NETWORK SECURITY** | ***3-0-0*** |
|---|---|---|

***Course Objective***

1. To learn the fundamentals of cryptography.
2. To learn the key management techniques and authentication approaches.
3. To explore the network and transport layer security techniques.
4. To understand the application layer security standards.
5. To learn the real time security practices

| | |
|---|---|
| ***UNIT** 1:* | Basics of cryptography, conventional and public-key cryptography, hash functions, authentication, and digital signatures. |
| ***UNIT** 2:* | KEY MANAGEMENT AND AUTHENTICATION: Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates ,Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption |
| ***UNIT** 3:* | ACCESS CONTROL AND SECURITY 4 Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web SecurityConsiderations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.. |
| ***UNIT** 4:* | APPLICATION LAYER SECURITY: Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail. Wireless Network Security: Mobile Device Security |
| ***UNIT** 5:* | SECURITY PRACTICES 6 Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. |

**Course Outcomes (COs)**

**By the end of this course, students will be able to:**

CO1: Explain the fundamentals of cryptography, including symmetric and asymmetric techniques, hash functions, and digital signatures.
CO2: Apply key management techniques and authentication protocols for secure communication in distributed systems.
CO3: Analyze access control mechanisms, network security protocols, and transport layer security for safeguarding data.
CO4: Evaluate application layer security mechanisms such as email security, wireless security, and secure web communication.
CO5: Design and implement security measures using firewalls, intrusion detection systems, and password management techniques.

TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN13:9780133354690.

REFERENCES:

1. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
2. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696.
3. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141- 1.
4. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10:1284031675, ISBN-13: 978-1284031676.
5. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specifice Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | H | M | L | - | - | - | - | - | - | M | - | L | H | M | |
| CO2 | M | H | M | M | - | - | - | - | - | M | - | M | H | H | M |
| CO3 | M | H | M | H | - | - | - | - | - | M | - | H | H | H | M |
| CO4<br>CO5 | L<br>L | M<br>M | H<br>H | M<br>M | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | H<br>H | -<br>- | H<br>H | H<br>H | M<br>H | L<br>L |

- H = Highly Related; M = Medium  L = Low

# CSE Track

# CSE

# Program Elective I

| MCO158A | Introduction To HCI | *3-0-0* |
|---|---|---|

***Course Objective***

***The objectives of this course are to:***

1. Introduce the fundamental concepts, interdisciplinary nature, and design principles of Human-Computer Interaction.
2. Develop understanding of qualitative and quantitative research methods for user need finding and analysis.
3. Familiarize students with HCI models, theories, and frameworks for analyzing human cognition and interaction.
4. Enable students to design, prototype, and evaluate interactive systems using appropriate methodologies.
5. Create awareness of recurring HCI challenges in diverse domains and approaches to address them.

| | |
|---|---|
| **UNIT** 1: | Introduction to HCI. What is HCI – Interdisciplinary nature of HCI – History of HCI – Importance of design and HCI – The design process -- The double diamond of design. |
| **UNIT** 2: | Need finding. Data collection (interviews, surveys, observational studies, contextual inquiry). Sampling. Qualitative data analysis (coding, thematic analysis/card sorting, focus group, inter-rater reliability, threads to validity, triangulation). Quantitative data analysis in need finding. Ethical considerations in human studies. |
| **UNIT** 3: | Models, theories and frameworks in HCI. What are they and why are they useful? Perception and memory. Model human processor. Information foraging. Activity theory. Distributed cognition. Mental models. |
| **UNIT** 4: | Prototyping (low-fi and hi-fi prototypes, use of metaphors). Evaluation (quantitative – controlled experiments, measures, statistical comparisons; qualitative – heuristics, cognitive walkthroughs, desirability and reaction toolkits, hallway usability study). |
| **UNIT** 5: | Recurring problems in HCI and ideas on how to approach them:Human-information interaction (search and browsing, information seeking and sensemaking, minimal learning);Human-AI interaction (role of the AI agent, challenges of non-determinism, explanation, trust, principles, wizard of oz methods);Human-robot interaction (Verbal and non-verbal interaction, embodiment, emotions, social robots and robots for autism);HCI for creativity support (nature of creative tasks and supporting them, focus and interruptions, cognitive load, case of programming);HCI for development (the minimum common denominator, constraints, the next billion users, cultural aspects);HCI for collaboration (social mechanisms in collab, facilitating communication and coordination, awareness and catching up, personal vs. professional) HCI for learning and education |

Practice Component: Assignments covering various aspects of the course to test drive cognitive principles, various design laws such as 80- 20, digit span etc. would be test driven. [6 sessions] Exercises would also involve form designs, interaction design paradigms, navigation design, usability and universal design guidelines & OO pseudocode for front end design. [8 sessions] Course would encourage use of tools such as Figma, Protopie, Adobe XD etc. to design and develop various concepts of the course in addition to a course project

***At the end of the course, the student should be able to:***

CO1: Explain the fundamentals and design processes in HCI, including interdisciplinary aspects and ethical considerations.
CO2: Apply qualitative and quantitative data collection and analysis methods for user need identification.
CO3: Analyze HCI models, theories, and frameworks for understanding user interactions and cognitive processes.
CO4: Design, prototype, and evaluate interactive systems using usability principles and evaluation techniques.
CO5: Address recurring HCI challenges in AI, robotics, creativity, education, and collaborative environments with suitable solutions.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specifice Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| CO1 | H | M | L | | | | | | | M | | L | H | M | M |
| CO2 | M | H | M | M | | | | | | M | | M | H | H | M |
| CO3 | M | H | M | H | | | | | | M | | H | H | H | |
| CO4 | L | M | H | M | | | | | | H | | H | H | M | L |
| CO5 | L | M | H | M | | | | | | H | | H | H | H | L |

- H = Highly Related; M = Medium  L = Low

***Text Book***

1. Alan Dix, J Finlay, G D Abowd, R Beale Human Computer Interaction,Prentice Hall, 2003

Reference Books
1. Jakob Nielsen, Usability Engineering, Morgan Kauffman, 1993
2. Helander, Landauer, Prabhu, Handbook of Human Computer Interaction, 2 nd Edition, Elsevier, 1997.
3. Articles from Nielsen Norman Group relating to Usability and User Experience.

# CSE

# Program Elective II

| MCO160A | Database System Implementation | *3-0-1* |
|---|---|---|

**Course Objective**

1. Introduce advanced concepts of database architecture, storage, indexing, and data models.
2. Familiarize students with deductive, object-oriented, and object-relational database models.
3. Explain distributed and parallel database design, query optimization, and transaction management techniques.
4. Provide knowledge of advanced transaction processing and big data technologies.
5. Explore emerging trends like cloud databases, NoSQL databases, and modern data storage systems

| | |
|---|---|
| ***UNIT** 1:* | **Introduction and Database Architecture:** Database system concepts and architecture, Data models, schemas, and instances, Data independence and DBMS components, Data storage, indexing, and hashing techniques |
| ***UNIT** 2:* | **Deductive Databases:** Datalog and Recursion, Evaluation of Datalog program, Recursive queries with negation. Objected Oriented and Object Relational Databases: Modelling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases |
| ***UNIT** 3:* | **Distributed Data Storage:** Fragmentation and 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** 4:* | **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** 5:* | **Advanced Topics:** Distributed database concepts, Parallel and cloud databases, Introduction to NoSQL databases (MongoDB, Cassandra)<br>Big Data and emerging database technologies |

***At the end of the course, the student should be able to:***

CO1: Explain database architecture, data models, storage techniques, and indexing methods.
CO2: Apply deductive and object-oriented database concepts for complex data modeling.
CO3: Analyze distributed database systems for query processing, optimization, and transaction management.
CO4: Evaluate advanced transaction processing mechanisms for complex and long-duration transactions.
CO5: Explore and compare modern database technologies such as cloud databases, NoSQL, and big data systems.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | | | | | *M* | | | | | | | *H* | | *H* |
| *CO2* | *H* | *M* | *H* | | *H* | | | | *L* | | | *M* | *M* | *H* | |
| *CO3* | *H* | *M* | | *L* | | | | | | | *L* | *M* | *H* | | *M* |
| *CO4* | *H* | *M* | *M* | | | | | | | | *L* | | *M* | *M* | |
| *CO5* | *H* | *M* | *H* | | | *M* | | | *M* | | | *M* | *H* | *M* | |

- H = Highly Related; M = Medium  L = Low

***Text Book***

1. Abraham Silberschatz, Henry Korth, and S. Sudarshan, Database System Concepts, McGraw-Hill.

**Reference Books:**

1. Raghu Ramakrishnan, Database Management Systems, WCB/McGraw-Hill.
2. Bipin Desai, An Introduction to Database Systems, Galgotia.
3. J. D. Ullman, Principles of Database Systems, Galgotia.
4. R. Elmasri and S. Navathe, Fundamentals of Database Systems8, Addison-Wesley.
5. Serge Abiteboul, Richard Hull and Victor Vianu, Foundations of Databases. Addison-Wesley.

## Program Elective III

| MCO 016B | Information System Security | 3-0-0 |
|---|---|---|

**Course Objective:**

- To perform a risk assessment of an information system.
- To identify the security requirements for an information system.
- To use available government information system security resources when designing systems.

| | |
|---|---|
| **UNIT** 1: | **Introduction to Securities:** 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, fiestal structure, Data encryption standard (DES), Strength of DES, Idea of differential cryptanalysis, block cipher modes of operations, Triple DES |
| **UNIT** 2: | **Modular Arithmetic:** 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) encryption and decryption 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** 3: | **Message Authentication Codes:** Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Securehash algorithm (SHA)<br>**Digital Signatures:** Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), proof of digital signature algorithm |
| **UNIT** 4: | **Key Management and distribution:** Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure.<br>**Authentication Applications:** Kerberos<br>**Electronic mail security:** pretty good privacy (PGP), S/MIME. |
| **UNIT** 5: | **IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Introduction to Secure Socket Layer, Secure electronic, transaction (SET).<br>**System Security:** Introductory idea of Intrusion, Intrusion detection, Viruses and related threats,firewalls. |

**Outcomes:**

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

*CO1: Perform a risk assessment of an information system.*

*CO2: Identify the security requirements for an information system.*

*CO3:Use available government information system security resources when designing systems.*

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *M* | | | *L* | *L* | | | | | *M* | | *H* | | *M* |
| *CO2* | | | *H* | *M* | | | *H* | | | | *M* | | | *M* | |
| *CO3* | *H* | | | | *L* | *M* | | | | | | | *H* | | |

M

- H = Highly Related; M = Medium  L = Low

**Suggested Books:**

1. William Stallings, “Cryptography and Network Security: Principals and Practice”,Pearson Education.
2. Behrouz A. Frouzan: Cryptography and Network Security, TMH
3. Bruce Schiener, “Applied Cryptography”. John Wiley & Sons
4. Bernard Menezes,” Network Security and Cryptography”, Cengage Learning.
5. AtulKahate, “Cryptography and Network Security”, TMH

# CSE

## Program Elective IV

| | | |
|---|---|---|
| MCO 095B | **Soft Computing** | **3-0-0** |

**Course Objective**

To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrid models.

| | |
|---|---|
| UNIT 1: | **Introduction**: Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, Requirement of Soft computing, Major Areas of Soft Computing, applications of soft computing, Concept of Neural Network,Definition, advantage of Neural network, Application scope of Neural network, Fuzzy computing , Genetic Algorithms, Hybrid System. |
| UNIT 2: | **Neural Network**: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference b/w ANN and human brain, characteristic and applications of ANN, single layer network, Mcculloch Pitts Model, learning rules – Hebbian, Delta, Percepron learning and Windrow- Hoff, winner-take-all |
| UNIT 3: | **Perceptron:** Perceptron training algorithm, Linear separability , Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA, Introduction to Associative Memory, Adaptive Resonance theor y and Self Organizing Map and Radial Basis Function network, Recent Applications. |
| UNIT 4: | **Fuzzy Logic**: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions. Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, cuts for fuzzy sets, fuzzy decision making & Applications of fuzzy logic, Defuzzification methods. |
| UNIT 5: | **Genetic Algorithm**: Fundamental, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods, Genetic-neuro hybrid systems, Genetic- Fuzzy rule based system. |

**Course Outcomes:**

CO1. Learn soft computing techniques and their applications.
CO2. Understand perceptrons and analyze various neural network architectures.
CO3. Understand and explain the fuzzy systems.
CO4. Understand and analyze the genetic algorithms and their applications.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | | | | | | | | | | H | | | |
| CO2 | H | H | | | M | | | | | | | | | | |
| CO3 | M | M | | | | | | | | | | | M | H | |
| CO4 | H | H | M | | M | | | | | | | H | M | M | |

*H = Highly Related; M = Medium; L = Low*

## Text Books


1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, 2nd Edition, Wiley, 2011
2. Timothy J. Ross, Fuzzy Logic with engineering applications, John Wiley & Sons, 2016.
3. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
4. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998 3.
5. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control Narosa Pub., 2001.

| MCO 011A | Cloud Computing: Course Outlines | 3-0-2 |
|---|---|---|

**Course Objective:**

1. To familiarize the philosophy, power, practical use of cloud.
2. To introduce fundamental principles, technology, and techniques of CC
3. To Discuss common problems that can be best solved with/in cloud
4. To Eliminate misconceptions about cloud computing

| | |
|---|---|
| **UNIT 1:** | Understanding cloud computing: Introduction to Cloud Computing - Benefits and Drawbacks - Types of Cloud Service Development - Deployment models |
| **UNIT 2:** | Cloud Architecture Technology and Architectural Requirements: The Business Case for Clouds - Hardware and Infrastructure – Accessing the cloud – Cloud Storage – Standards- Software as a Service – Discovering Cloud Services Development tools. Three Layered Architectural Requirement - Provider Requirements |
| **UNIT 3:** | Service Centric Issues - Interoperability - QoS - Fault Tolerance - Data Management Storage and Processing - Virtualization Management - Scalability - Load Balancing - Cloud Deployment for Enterprises - User Requirement - Comparative Analysis of Requirement. |
| **UNIT 4:** | Security Management in Cloud: Security Management Standards - Security Management in the Cloud Availability Management - SaaS Availability Management - PaaS Availability Management - IaaS Availability Management - Access Control - Security Vulnerability, Patch, and Configuration Management – Privacy in Cloud- The Key Privacy Concerns in the Cloud - Security in Cloud Computing. |
| **UNIT 5:** | Virtualization: Objectives - Benefits - Virtualization Technologies - Data Storage Virtualization – Storage Virtualization – Improving Availability using Virtualization - Improving Performance using Virtualization- Improving Capacity using Virtualization. |

## Outcomes:

### At the end of the course, the student should be able to:

CO1: Identify the philosophy, power, and practical use of cloud.

CO2: Present fundamental principles, technology, and techniques of CC

CO3: Solve common problems that can be encountered during setup of virtual server and storage.

CO4: Build understanding of key privacy concerns in cloud security management.

**Text books:**


1. David S Linthicum, "Cloud Computing and SOA Convergence in your Enterprise A Step by Step Guide", Addison Wesley Information Technology Series.
2. Anthony T Velte, Toby J.Velte, Robert Elsenpeter, "Cloud computing A Practical Approach ", Tata McGraw Hill Publication


**References:**


1. Tim Mather, Subra Kumara swamy, Shahed Latif, "Cloud Security and Privacy –
2. An Enterprise Perspective on Risks and Compliance" , O'Reilly Publications, First Edition
3. Michael Miller, "Cloud Computing – Web-Based Applications that Change the Way You Work and Collaborate Online", Pearson Education, New Delhi, 2009.
4. Cloud Computing Specialist Certification Kit – Virtualization Study Guide.


### *Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:*

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | H | | L | | H | | | | | | | *M* | | | L |
| *CO2* | | | | | | | | | H | | L | | H | L | |
| *CO3* | | | H | | | | | | | | | | | H | *H* |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *CO4* | | H | | | | M | H | | | | | | *H* | | |

*H = Highly Related; M = Medium L = Low*

| MCO 101A | Neural Networks Programming Techniques | 3-0-0 |
|---|---|---|

**Course Objective:**

- To explain basic concepts of neuron networks
- To explain multiple models of neural networks
- To understand applications of neural networks

| | |
|---|---|
| **UNIT** 1: | Basics of ANN: Models to Neuron; Basic learning laws. Activation and Synaptic Dynamics: Activation dynamics models; Synaptic dynamics models; Stability and Convergence. |
| **UNIT** 2: | Analysis of Feed forward Neural Networks: Linear associative networks for pattern association; Single layer and Multilayer Perception network for pattern classification; Multi layer feed forward neural networks for pattern mapping |
| **UNIT** 3: | **Analysis of Feedback Neural Networks:** Linear auto associative networks; Hopfield model for pattern storage; stochastic networks; Boltzmann machine for pattern environment storage. |
| **UNIT** 4: | Competitive Learning Neural Networks: Basic competitive learning laws; Analysis of pattern clustering networks; Analysis of self-organizing feature mapping networks |
| **UNIT 5:** | Applications of ANN: Pattern classification problems; Optimization; Control. |

***Outcomes***

At the end of this course Students will be able to:

- Explain basic concepts of neural networks
- Explain different feed forward networks
- Explain different feedback networks
- Explain competitive learning
- Understand applications of ANN

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | | | | | | | | | | H | M | | M |
| CO2 | H | H | | | M | | | | | | | | | | |
| CO3 | M | M | | | | | | | | | | | M | H | |
| CO4 | H | H | M | | M | | | | | | | H | M | M | L |

- H = Highly Related; M = Medium; L = Low

***Texts/References:***

1. J.A. Anderson, An Introduction to Neural Networks, MIT

**Reference Books:**

1. Hagen Demuth Beale, Neural Network Design, Cengage Learning
2. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson India
3. Kosko, Neural Network and Fuzzy Sets, PHI

# Cyber Security Track

## Cyber Security

## Program Elective I

| MCO 016A | Information System Security | 3-0-0 |
|---|---|---|

**Course Objective:**

- To perform a risk assessment of an information system.
- To identify the security requirements for an information system.
- To use available government information system security resources when designing systems.

| | |
|---|---|
| **UNIT** 1: | **Introduction to Securities:** 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, fiestal structure, Data encryption standard (DES), Strength of DES, Idea of differential cryptanalysis, block cipher modes of operations, Triple DES |
| **UNIT** 2: | **Modular Arithmetic:** 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) encryption and decryption 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** 3: | **Message Authentication Codes:** Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Securehash algorithm (SHA)<br>**Digital Signatures:** Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), proof of digital signature algorithm |
| **UNIT** 4: | **Key Management and distribution:** Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure.<br>**Authentication Applications:** Kerberos<br>**Electronic mail security:** pretty good privacy (PGP), S/MIME. |
| **UNIT** 5: | **IP Security:** Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Introduction to Secure Socket Layer, Secure electronic, transaction (SET).<br>**System Security:** Introductory idea of Intrusion, Intrusion detection, Viruses and related threats,firewalls. |

**Outcomes:**

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

*CO1: Perform a risk assessment of an information system.*
*CO2: Identify the security requirements for an information system.*
*CO3:Use available government information system security resources when designing systems.*

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *M* | | | *L* | *L* | | | | | *M* | | *H* | | *M* |
| *CO2* | | | *H* | *M* | | | *H* | | | | *M* | | | *M* | |
| *CO3* | *H* | | | | *L* | *M* | | | | | | | *H* | | |

M

- H = Highly Related; M = Medium  L = Low

**Suggested Books:**

1. William Stallings, “Cryptography and Network Security: Principals and Practice”,Pearson Education.
2. Behrouz A. Frouzan: Cryptography and Network Security, TMH
3. Bruce Schiener, “Applied Cryptography”. John Wiley & Sons
4. Bernard Menezes,” Network Security and Cryptography”, Cengage Learning.
5. AtulKahate, “Cryptography and Network Security”, TMH

## Cyber Security

## Program Elective II

| MCO 057B | Ethical Hacking | 3-0-0 |
|---|---|---|

**Course Objective:** By the end of the course students will able to:

1. Learn various hacking methods.
2. Perform system security vulnerability testing.
3. Perform system vulnerability exploit attacks.
4. Produce a security assessment report
5. Learn various issues related to hacking.

| | |
|---|---|
| UNIT 1: | **Hacking Windows:** BIOS Passwords, Windows Login Passwords, Changing Windows Visuals, Cleaning Your Tracks, Internet Explorer Users, Cookies, URL Address Bar, Netscape Communicator, Cookies, URL History, The Registry, Baby Sitter Programs. |
| UNIT 2: | **Advanced Windows Hacking:** Editing your Operating Systems by editing Explorer.exe, The Registry, The Registry Editor, Description of .reg file, Command Line Registry Arguments, Other System Files, Some Windows & DOS Tricks, Customize DOS, Clearing the CMOS without opening your PC, The Untold Windows Tips and Tricks Manual, Exiting Windows the Cool and Quick Way, Ban Shutdowns: A Trick to Play, Disabling Display of Drives in My Computer, Take Over the Screen Saver, Pop a Banner each time Windows Boots, Change the Default Locations, Secure your Desktop Icons and Settings. |
| UNIT 3: | **Getting Past the Password:** Passwords: An Introduction, Password Cracking, Cracking the Windows Login Password, The Glide Code, Windows Screen Saver Password, XOR, Internet Connection Password, Sam Attacks, Cracking Unix Password Files, HTTP Basic Authentication, BIOS Passwords, Cracking Other Passwords, . |
| UNIT 4: | **The Perl Manual:** Perl: The Basics, Scalars, Interacting with User by getting Input, Chomp() and Chop(), Operators, Binary Arithmetic Operators, The Exponentiation Operator(**), The Unary Arithmetic Operators, Other General Operators, Conditional Statements, Assignment Operators. The?: Operator, Loops, The While Loop, The For Loop, Arrays, THE FOR EACH LOOP: Moving through an Array, Functions Associated with Arrays, Push() and Pop(), Unshift() and Shift(), Splice(), Default Variables, $_, @ARGV, Input Output, Opening Files for Reading, Another Special VariableS. |

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|---|---|
| UNIT 5: | **How does a Virus Work?** What is a Virus?, Boot Sector Viruses (MBR or Master Boot Record), File or Program Viruses, Multipartite Viruses, Stealth Viruses, Polymorphic Viruses, Macro Viruses, Blocking Direct Disk Access, Recognizing Master Boot Record (MBR) Modifications, Identifying Unknown Device Drivers, How do I make my own Virus?, Macro Viruses, Using Assembly to Create your own Virus, How to Modify a Virus so Scan won‟t Catch it, How to Create New Virus Strains, Simple Encryption Methods. |

***Course Outcome (CO):***

*At the end of this course, students will demonstrate ability to:*

1. Work on various hacking methods and use this method to stop cyber-crime.
2. Implement system security vulnerability testing and make system more secure.
3. Analyze system vulnerability exploit attacks and make some preventive measure for secure system.
4. Generate a security assessment report
5. Analyze various issues related to hacking.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specifice Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *M* | | *H* | | | *L* | | *M* | | | | *M* | *M* | *L* | |
| *CO2* | *M* | | *H* | *H* | *H* | *H* | *L* | *M* | | | | | *H* | *M* | |
| *CO3* | *M* | *H* | *M* | *H* | *M* | *L* | | *M* | *L* | | *M* | | *H* | *M* | *H* |
| *CO4* | | | | | *L* | | | *M* | | | | *H* | | *M* | |
| *CO5* | | *H* | | *H* | *M* | *L* | *L* | *M* | *L* | | | *H* | *H* | | *H* |

**TEXT BOOKS:**

1. Patrick Engbreston: “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy”,1st Edition, Syngress publication,2011.
2. Ankit Fadia : “Unofficial Guide to Ethical Hacking”, 3rd Edition , McMillan India Ltd,2006.

**REFERENCES:**

1. Simpson/backman/corley, “HandsOn Ethical Hacking & Network Defense International”, 2nd Edition,Cengageint,2011.

## Cyber Security

## Program Elective 3

| | | | |
|---|---|---|---|
| MCO 064B | | **Digital Forensics** | **3-0-0** |

**Course Objective:**

1. The main objective of the course is to introduce the students to bring awareness in crimes and tracing the attackers.
2. Define digital forensics from electronic media.
3. Describe how to prepare for digital evidence investigations and explain the differences between law enforcement agency and corporate investigations.
4. Explain the various forensic technologies and protection of data.
5. To get familiarize with various Risk Management Techniques and their use.

| | |
|---|---|
| **UNIT 1:** | Introduction & evidential potential of digital devices – Key developments, Digital devices in society, Technology and culture, Comment, Closed vs. open systems, evaluating digital evidence potential.<br>Device Handling & Examination Principles: Seizure issues, Device identification, Networked devices, Contamination, Previewing, Imaging, Continuity and hashing, Evidence locations. |
| **UNIT 2:** | A sevenelement security model, A developmental model of digital systems, Knowing, Unknowing, Audit and logs , Data content, Data context. Internet & Mobile Devices The ISO / OSI model, The internet protocol suite, DNS, Internet applications, Mobile phone PDAs, GPS, Other personal technology. |
| **UNIT 3:** | Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources / Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?, Case Histories, Case Studies. |
| **UNIT 4:** | Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised, Internet Tracing Methods 65. |
| **UNIT 5:** | Homeland Security Systems. Occurrence of Cyber Crime, Cyber Detectives, Fighting Cyber Crime with Risk Management Techniques, Computer Forensics Investigative Services, Forensic Process Improvement, Course Content, Case Histories. |

***Course Outcome (CO):***

***At the end of this course, students will demonstrate ability to:***

CO1: The students are aware about cyber-crimes and tracing the attackers.
CO2: Learn about digital forensics and collection of digital forensics from electronic media.
CO3: Describe how to prepare for digital evidence investigations and explain the differences between law enforcement agency and corporate investigations.
CO4. Explain the various forensic technologies and protection of data.
CO5. To get familiarize with various Risk Management Techniques and their use.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *M* | *M* | *M* | | *L* | | *M* | | *L* | | *M* | *H* | *M* | *M* |
| *CO2* | *H* | | *M* | *H* | *M* | *H* | *L* | | *L* | | *L* | *L* | *H* | *M* | *M* |
| *CO3* | *M* | *M* | | *M* | | | *L* | *L* | | *M* | | | | *M* | |
| *CO4* | *L* | | *M* | | | | | *M* | | *L* | | *L* | *L* | | |
| *CO5* | *M* | *M* | | | *M* | | *M* | | | | | *L* | | *M* | |

L

**TEXT BOOKS:**

1. Angus M.Mashall, "Digital Forensics", 2nd Edition,Wiley-Blackwell, A John Wiley & Sons Ltd Publication, 2008.

2. John R. Vacca, " Computer forensics : Computer Crime Scene Investigation", 2nd Edition, Charles River Media, Inc. Boston, Massachusetts.

**REFERENCES:**

1. Michael G. Noblett; Mark M. Pollitt, Lawrence A. Presley (October 2000), "Recovering and examining computer forensic evidence", Retrieved 26 July 2010.

2. Leigland, R (September 2004). "A Formalization of Digital Forensics".(Pdf document ).

3. Geiger, M (March 2005). "Evaluating Commercial Counter-Forensic Tools" (Pdf document).

## Cyber Security

## Program Elective 4

| MCO 059B | **SECURITY THREATS & VULNERABILITIES** | **3-0-0** |
|---|---|---|

**Course Objective:**

1. To impart the knowledge on various security threats and issues and how to overcome those issues.
2. To identify and explain the capability to handle various attackers and crime issues.
3. To educate various issues involved in threats overcome methods.
4. To impart the knowledge on various Forensic analysis and risk analysis.
5. To familiarize students with inner security issues involved in mail agents, viruses and worms.

| | |
|---|---|
| UNIT 1: | Introduction: Security threats - Sources of security threats- Motives - Target Assets and Vulnerabilities. Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers,Insider threats, Cyber crimes. |
| UNIT 2: | Network Threats: Active/ Passive – Interference – Interception – Impersonation – Worms – Virus – Spam"s – Ad ware - Spy ware – Trojans and covert channels – Backdoors – Bots - IP Spoofing - ARP spoofing - Session Hijacking - Sabotage-Internal treats- Environmental threats - Threats to Server security. |
| UNIT 3: | Security Threat Management: Risk Assessment - Forensic Analysis - Security threat correlation – Threat awareness - Vulnerability sources and assessment-Vulnerability assessment tools - Threat identification - Threat Analysis - Threat Modeling - Model for Information Security Planning. |
| UNIT 4: | Security Elements: Authorization and Authentication - types, policies and techniques - Security certification - Security monitoring and Auditing - Security Requirements Specifications - Security Policies and Procedures, Firewalls, IDS, Log Files, Honey Pots |
| UNIT 5: | Access control, Trusted Computing and multilevel security - Security models, Trusted Systems, Software security issues, Physical and infrastructure security, Human factors – Security awareness, training, Email and Internet use policies. |

**At the end of the course, the student should be able to:**

CO1. The Student will gain the knowledge on various security threats and issues and how to overcome those issues.

CO2. The student will get the capability to handle various attackers and crime issues.

CO3. Learning various issues involved in threats overcome methods.

CO4. Learning Forensic analysis and risk analysis.

CO5. Learn inner security issues involved in mail agents, viruses and worms.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *M* | *M* | | *M* | | *L* | | | *L* | *M* | *L* | *M* | *H* | |
| *CO2* | | *M* | *M* | | *H* | *L* | *L* | | | | *M* | *L* | | *L* | *M* |
| *CO3* | *H* | *M* | *M* | *M* | | *L* | | *L* | | | *L* | | *H* | *L* | *H* |
| *CO4* | | *M* | | | | | *M* | | | | *M* | | *M* | *M* | |
| *CO5* | *M* | | | *H* | | | | | *L* | *L* | | | *M* | | |

- H = Highly Related; M = Medium  L = Low

**TEXT BOOKS:**

1. Swiderski, Frank and Syndex: “Threat Modeling”, 1st Edition, Microsoft Press, 2004.
2. Joseph M Kizza: “Computer Network Security”, 1st Edition, Springer, 2010.
3. William Stallings and Lawrie Brown: “Computer Security: Principles and Practice”, 2nd Edition Prentice Hall, 2008.

**REFERENCES:**

1. Lawrence J Fennelly : “Handbook of Loss Prevention and Crime Prevention” 5th Edition, Butterworth-Heinemann,2012.
2. Tipton Ruthbe Rg : “Handbook of Information Security Management”, 6th Edition, Auerbach Publications,2010.
3. Mark Egan : “The Executive Guide to Information Security” , 1st Edition, Addison-Wesley Professional,2004.

## Cyber Security

## Program Elective 5

| MCO 058B | Cyber Laws And Security Policies | 3-0-0 |
|---|---|---|

**Course Objective:**

1. To introduce the various cyber laws and their legal perspective.
2. To get familiarize with various Act related to information technology.
3. To aware the students with e business and legal issues.
4. To introduce the cyber ethics in various fields.
5. To provide practical exposure on cyber crime.

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| **UNIT 1:** | **Introduction to Cyber Law Evolution of Computer Technology** : Emergence of Cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access. |
| **UNIT 2:** | **Information technology Act** : Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication. |
| **UNIT 3:** | **Electronic Business and legal issues**: Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security.<br>**Application area:** Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends. |
| **UNIT 4:** | **Cyber Ethics:** The Importance of Cyber Law, Significance of cyber-Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics. |
| **UNIT 5:** | **Case Study on Cyber Crimes:** Harassment Via E-Mails, Email Spoofing (Online A Method Of Sending E-Mail Using A False Name Or E-Mail Address To Make It Appear That The E-Mail Comes From Somebody Other Than The True Sender, Cyber Pornography (Exm.MMS), Cyber-Stalking |

**At the end of the course, the student should be able to:**

1. Familiar with various cyber laws and their legal perspective with practical aspects.
2. Know about various Act related to information technology.
3. Enhance their skills in the field e-business and legal issues in cyber space.

4. Learn the cyber ethics in various fields and their significance.
5. Get the practical exposure on cyber-security.

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *L* | | | *H* | | *M* | | | | | *L* | | *H* | *M* | *M* |
| *CO2* | | | | | | | *L* | | | | *L* | | *H* | | |
| *CO3* | *M* | | *M* | | | *M* | | | | *L* | | *M* | | *H* | |
| *CO4* | | | | | | | *M* | *H* | | | | | | *L* | *M* |
| *CO5* | *L* | | *L* | | *M* | *M* | | | | | *H* | *M* | *H* | *M* | |

**TEXT BOOKS :**

1 .K.Kumar," Cyber Laws: Intellectual property & E Commerce, Security",1st Edition, Dominant Publisher,2011.
2. Rodney D. Ryder, " Guide To Cyber Laws", Second Edition, Wadhwa And Company, New Delhi, 2007.
3. Information Security policy &implementation Issues, NIIT, PHI.

**REFERENCES :**

1. Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, 2nd Edition,PHI,2003.
**2.** Justice Yatindra Singh, " Cyber Laws", Universal Law Publishing, 1st Edition,New Delhi, 2003.
3. Sharma, S.R., "Dimensions Of Cyber Crime", Annual Publications Pvt. Ltd., 1st Edition, 2004.
4. Augastine, Paul T.," Cyber Crimes And Legal Issues", Crecent Publishing Corporation, 2007.

| MCO 061B | Ethical Hacking And Digital Forensic Tools Lab | 0-0-2 |
|---|---|---|

**Course Objectives:**
The main objective this practical session is that students will get the exposure to various forensic tools and scripting languages.

The following programs should be implemented preferably on platform Windows/Unix through perl, shell scripting language and other standard utilities available with UNIX systems. :-

**Part A :**

1. Write a perl script to concatenate ten messages and transmit to remote server
   a) Using arrays b) Without using arrays.

2. Write a perl script to implement following functions:
   a) Stack functions b) File functions c) File text functions
   d) Directory functions e) Shift, unshift, Splice functions.

3. Write a Perl script to secure windows operating systems and web browser by disabling Hardware and software units.
4. Write a perl script to implement Mail bombing and trace the hacker.
5. Write a shell script to crack UNIX login passwords and trace it when breaking is happened.

**Part B: Exposure on Forensic tools.**

1. Backup the images file from RAM using Helix3pro tool and show the analysis.
2. Introduction to Santhoku Linux operating system and features extraction.
3. Using Santoku operating system generates the analysis document for any attacked file from by taking backup image from RAM.
4. Using Santoku operating system generates the attacker injected viewing java files.
5. Using Santoku operating system shows how attackers opened various Firefox URL‟s and pdf document JavaScript files and show the analysis.
6. Using Santoku operating System files show how an attacker connected to the various network inodes by the specific process.
7. Using exiftool (-k) generate the any picture hardware and software.
8. Using deft_6.1 tool recover the attacker browsing data from any computer.

**Using Courier tool Extract a hacker secret bitmap image hidden data.**

10. Using sg (Stegnography) cyber Forensic tool hide a message in a document or any file.
11. Using sg cyber Forensic tool unhide a message in a document or any file.
12. Using Helix3pro tool show how to extract deleted data file from hard disk or usb device.
13. Using Ghostnet tool hide a message into a picture or any image file.
14. Using kgbkey logger tool record or generate an document what a user working on system
15. Using pinpoint metaviewr tool extract a metadata from system or from image file.
16. Using Bulk Extractor tool extract information from windows file system.

**Course Outcomes:**

By the completion of this laboratory session Student

1. Will get the practical exposure to forensic tools.
2. Will gain the knowledge on perl and Unix scripting languages to implement various security attacks.
3. Will get the ideas in various ways to trace an attacker.

| MCO 061 B | Cryptography And Security Lab | **0-0-2** |
|---|---|---|

**Course Educational Objectives:**
The objective of this course is that to understand the principles of encryption algorithms, conventional and public key cryptography practically with real time applications.

The following programs should be implemented preferably on platform Windows/Unix using C language (for 1-5) and other standard utilities available with UNIX systems (for 6-15) :-

1. Implement the encryption and decryption of 8-bit data using Simplified DES Algorithm (created by Prof. Edward Schaefer) in C
2. Write a program to break the above DES coding
3. Implement Linear Congruential Algorithm to generate 5 pseudo-random numbers in C
4. Implement Rabin-Miller Primality Testing Algorithm in C
5. Implement the Euclid Algorithm to generate the GCD of an array of 10 integers in C
6. a)Implement RSA algorithm for encryption and decryption in C
   b) In an RSA System, the public key of a given user is e=31,n=3599.
Write a program to find private key of the User.
7. Configure a mail agent to support Digital Certificates, send a mail and verify the correctness of this system using the configured parameters.
8. Configure SSH (Secure Shell) and send/receive a file on this connection to verify the correctness of this system using the configured parameters.
9. Configure a firewall to block the following for 5 minutes and verify the correctness of this system using the configured parameters: (a) Two neighborhood IP addresses on your LAN (b) All ICMP requests (c) All TCP SYN Packets
10. Configure S/MIME and show email-authentication.
11. Implement encryption and decryption with openssl.
12. Implement Using IP TABLES on Linux and setting the filtering rules.
13. Implementation of proxy based security protocols in C or C++ with features like Confidentiality, integrity and authentication.
14. Working with Sniffers for monitoring network communication (Ethereal)
15. Using IP TABLES on Linux and setting the filtering rules

**Course Outcomes:**
By the end of the course students will
1. Know the methods of conventional encryption.
2. Understand the concepts of public key encryption and number theory
3. Understand various applications of cryptography and security issues practically.

## Cyber Security

## Program Elective 6

| | | |
|---|---|---|
| MCO 069B | Information Security Risk Management | **3-0-0** |

**Course Objective**

To understand and development of concepts required for risk-based planning and risk management of computer and information systems

| | |
|---|---|
| UNIT 1: | An Introduction to Risk Management: Introduction to the Theories of Risk Management; The Changing Environment; The Art of Managing Risks. |
| UNIT 2: | The Threat Assessment Process: Threat Assessment and its Input to Risk Assessment; Threat Assessment Method; Example Threat Assessment |
| UNIT 3: | Vulnerability Issues: Operating System Vulnerabilities; Application Vulnerabilities; Public Domain or Commercial Off-the-Shelf Software; Connectivity and Dependence; Vulnerability assessment for natural disaster, technological hazards, and terrorist threats; implications for emergency response, vulnerability of critical infrastructures |
| UNIT 4: | The Risk Process: What is Risk Assessment? Risk Analysis; Who is Responsible? |
| UNIT 5: | Tools and Types of Risk Assessment: Qualitative and Quantitative risk Assessment; Policies, Procedures, Plans, and Processes of Risk Management; Tools and Techniques; Integrated Risk Management; Future Directions: The Future of the Risk Management. |

**At the end of the course, the student should be able to:**

CO1: The ability to identify, analyse and articulate the importance of managing IS-related risk and security issues in organizations, and the relationship between these and the achievement of business value from IS/IT investments

CO2: The ability to identify, analyse, synthesize and evaluate the costs of not appropriately identifying and managing risk and security concerns in projects and organizations, resulting in IS/IT failures, dysfunctional systems, and systems which fail to deliver value to key stakeholders

CO3: The practical ability to develop and document IS/IT risk and security management plans that detail contingency planning strategies and practices

CO4:The ability to identify, analyze, synthesize and articulate the major theories and concepts associated with IS failure and the management of IS risk, including factors argued to lead to unsatisfactory outcomes with respect to IS/IT and Information Security

***MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:***

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *H* | | *M* | | *L* | | | | | *L* | | *H* | *M* | |
| *CO2* | | | | *M* | *M* | | *L* | *M* | | *M* | | *L* | *M* | | *M* |
| *CO3* | | | *H* | | | *M* | | | | *M* | | *L* | | *M* | |
| *CO4* | | | | *M* | *M* | | *M* | *M* | | | *H* | | *M* | | *M* |

**Text books:**

1. Malcolm Harkins, Managing Risk and Information Security, Apress, 2012.
2. Daniel Minoli, Information Technology Risk Management in Enterprise Environments, Wiley, 2009.

**Reference books**:

1. Andy Jones, Debi Ashenden ,Risk Management for Computer Security: Protecting Your Network & Information Assets, , 1st Edition, Butterworth-heinemann, Elsevier, 2005.
2. Andreas Von Grebmer, Information and IT Risk Management in a Nutshell: A pragmatic approach to Information Security, 2008, Books on Demand Gbh.

# Artificial Intelligence Track

# Artificial Intelligence
# Program Elective 1

| MCO 117A | Principles of Artificial Intelligence & Machine Learning | 3-0-0 |
|---|---|---|

**Course Objective:**

- Able to explain the basic principles of artificial intelligence
- Students can apply logic and structured concepts in knowledge representation and discuss the applications of artificial intelligence
- To implement and analyze uninformed and informed Search Strategies
- To implement and apply various game playing algorithms to different problems
- Understand and represent various types of logics and their forms
- To Understand various Learning techniques

| | |
|---|---|
| **UNIT 1:** | **Introduction**- What is intelligence? Foundations of artificial intelligence (AI), Task of artificial intelligence, Techniques of artificial intelligence, Problem Solving Formulating problems, problem types, states and operators, state space.<br><br>Knowledge Representation- Role of Knowledge, Declarative Knowledge, Procedural Knowledge, Knowledge representation Techniques; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation |
| **UNIT 2:** | **Uninformed & Informed Search Strategies**- Breath First Search, Depth First Search, Depth Limited Search, Heuristic Functions, Best First Search, Hill Climbing Algorithm, Problems and solutions of Hill Climbing, Iterative Deepening (IDA), A* algorithm, AO* Algorithm. |
| **UNIT 3:** | **Game playing**- Introduction, Types of games, Minimax game algorithm, Alpha Beta cut-off procedure**.** Case Study of Games |
| **UNIT 4:** | **Logics- P**ropositional logics, First Order Predicate Logics (FOPL), Syntax of First Order Predicate Logics, Properties of Wff, Clausal Forms, Conversion to clausal forms. |
| **UNIT 5:** | **Machine Learning-** Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system- Training data, Concept representation, Function approximation, Issues in machine learning. Types of machine learning-Learning associations. Supervised learning - Classification and regression trees, Support vector machines. Unsupervised learning - Clustering, Instance-based learning , K-nearest neighbor, Locally weighted regression, Radial basis function, Reinforcement learning |

**Course Outcomes**: Upon the end of this course, student will be :

CO1: Familiar with the basic principles of artificial intelligence

CO2: To implement and analyze Uninformed and Informed Search algorithms

CO3: Able to represent and apply various logics and structured concepts in knowledge representation

CO4: To implement and apply various game playing algorithms to different problems

CO5: To understand various Learning techniques

**COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| *CO1* | *H* | *L* | *L* | *M* | | | | | | | | *H* | *L* | | |
| *CO2* | *H* | *H* | *H* | *M* | *H* | | | | *H* | | *M* | *H* | *M* | | |
| *CO3* | *H* | *M* | *M* | *H* | *H* | *L* | | *L* | *M* | | *M* | *H* | *M* | *M* | |
| *CO4* | *H* | *M* | *M* | *H* | *H* | *L* | | *L* | *H* | | *M* | *H* | *H* | *M* | |
| *CO5* | *H* | *M* | | | | | | | *M* | | | *H* | *L* | | *M* |

***H = Highly Related; M = Medium L = Low***

**Text Books:**

1. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press, 2001.
2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.
3. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

**Reference Books:**

1. George F. Luger, Artificial Intelligence, Pearson Education, 2001.

2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

# Artificial Intelligence
# Program Elective 2

| MCO 090B | Knowledge Engineering and Expert Systems | 3-0-0 |
|---|---|---|

**Course Objective:** At the end of the course, the student should be able to:

- To explain and describe the concepts central to the creation of knowledge bases and expert systems.
- Knowledgeable about the tools and the processes used for the creation of an expert system.
- Student will know methods used to evaluate the performance of an expert system.
- Students will be able to examine properties of existing systems in a case-study manner, comparing differing approaches and software tools

| | |
|---|---|
| **UNIT1** | **Introduction To Knowledge Engineering**: The Human Expert And An Artificial, Expert Knowledge Base And Inference Engine, Importance of Expert System, features of Expert System, Knowledge Acquisition And Knowledge Representation, Components of a Knowledge in Expert system |
| **UNIT2** | **Knowledge Acquisition & Problem Solving process**: Introduction, Knowledge Acquisition and domain Expert, Selection of the domain, Selection of the Knowledge Engineers, Meetings and Plans, Organization of Meetings ,Documentation, Multiple domain Experts. Selecting the appropriate Problem, Rule Based Systems, and Heuristic Classifications Constructive Problem Solving. |
| **UNIT3** | **Design of Expert System**: Introduction, Stages in the Developing Expert System, Errors in Development stages, Software Engineering and Expert Systems, The Expert System Life Cycle, Expert System Design Examples, Case Based Reasoning, Semantic of Expert, Systems. |
| **UNIT4** | **Inference Engine**: Inference Engine, Insight of Inference Engine, Search Strategies, Forward Chaining Algorithm, Algorithms for forward Chaining- Baseline Version, Backward Chaining Algorithm, Algorithms for Backward Chaining-Baseline Version, Mixed Modes of Chaining, Work sheets for Forward and Backward Chaining |
| **UNIT 5** | **Software Tools**: Overview of Expert System Tools, Expert System Shells, Multiple Paradigm Environments, Abstract architectures, Potential Implementation Problems, Selecting a Software Tool, Implementation Mechanism of tools, Black Board Architecture, Reasoning under uncertainty and Truth Maintenance Systems, Case-study : DENDRAL and MYCIN |

**Course Outcome:**

CO1. To get introduced to the basic knowledge representation in Expert system
CO2. Understand the Knowledge Acquisition & Problem Solving methods
CO3. Understand, analyze and evaluate the performance of an expert system.
CO4. Understand and identify various rules in inference engine
CO5. Identify ,apply and compare Expert system software tool to solve real life problems

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | *H* | *H* | *M* | | | | | | | | | *H* | | | |
| *CO2* | *H* | *H* | *H* | | | | | | | | | *M* | | *M* | |
| *CO3* | *H* | *M* | *M* | *M* | *M* | | | | | | *M* | *H* | *M* | *M* | |
| *CO4* | *H* | *M* | *M* | *M* | *M* | | | | | | | *M* | | *M* | |
| *CO5* | *H* | *M* | *M* | *M* | *M* | *M* | | | | | *M* | *M* | *H* | *H* | |

*H = Highly Related; M = Medium; L = Low*

**Text Books:**

1. Peter Jackson, “Introduction to Expert Systems”,3rd Edition, Pearson Education 2007.
2. Robert I. Levine, Diane E. Drang, Barry Edelson: “ AI and Expert Systems: a comprehensive guide, C language”, 2nd edition, McGraw-Hill 1990.
3. Jean-Louis Ermine: “Expert Systems: Theory and Practice”, 4th printing, Prentice-Hall of India , 2001.
4. Stuart Russell, Peter Norvig: “Artificial Intelligence: A Modern Approach”,2nd Edition,Pearson Education, 2007.
5. Padhy N.P.: “Artificial Intelligence and Intelligent Systems”,4th impression , Oxford University Press, 2007.

# Artificial Intelligence
# Program Elective 3

| MCO 082B | Pattern Recognition | 3-0-0 |
|---|---|---|

**Course Objective**

- Understand how to generate pattern and explain how to analyze pattern features
- Understand how to build classifiers using non parametric methods.
- Learn and compare principles of parametric and non parametric classification
- Implement pattern recognition and machine learning theories
- Able to apply the pattern recognition theories to applications of interest

| | |
|---|---|
| Module 1: | **Pattern Recognition Overview**<br>Overview of Pattern Recognition- Relations of PR with other Systems, PR Applications, Different Approaches to Pattern Recognition, Classification and Description—Patterns and feature extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches. |
| Module 2: | **Statistical Pattern Recognition** Introduction to statistical Pattern Recognition, Gaussian Case and Class Dependency, Discriminate Function, Examples, Classifier Performance, |
| Module 3: | **Linear Discriminant Functions and Unsupervised Learning and Clustering** Introduction—Discrete and binary Classification problems—Techniques to directly obtain linear Classifiers, Formulation of Unsupervised Learning Problems—Clustering for unsupervised learning and classification. |
| Module 4: | **Syntactic Pattern Recognition** Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars, Graphical Approaches to syntactic pattern recognition, Learning via grammatical inference. |
| Module 5: | **Recognition of Syntactic Description**<br>Recognition by Matching, Recognition by Parsing, CYK Parsing Algorithm, Augmented Transition Nets in Parsing, Graph Based structure representation, Structured Strategy to Compare Attributed Graphs |

At the end of the course, the student should be able to:

***Course Outcomes:***

CO1. Understand and explain the process of Pattern Recognition.

CO2. Apply probability theory to estimate classifier performance.

CO3. Describe and analyze the principles of parametric and non parametric classification methods.

CO4. Compare pattern classifications and pattern recognition techniques.

CO5. Apply Pattern Recognition techniques to real world problems & Design systems

| Course Outcome | Program Outcome | | | | | | | | | | | | Program Specific Outcome | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | *PSO3* |
| CO1 | H | M | | | | | | | | | | H | | | |
| CO2 | M | M | M | | | | | | | | | | M | M | |
| CO3 | H | H | | H | H | | | | | | | H | | | |
| CO4 | | | | | H | N | | | M | | | | H | M | |
| CO5 | | | | | H | M | | | M | | | H | H | H | |

***H = Highly Related; M = Medium L = Low***

**References:**


1. Robert Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John wiley& sons , Inc,1992.
2. Earl Gose, Richard johnsonbaugh, Steve Jost, "Pattern Recognition andImage Analysis", Prentice Hall of India,.Pvt Ltd, New Delhi, 1996.
3. Duda R.O., P.E.Hart& D.G Stork, " Pattern Classification", 2nd Edition, J.Wiley Inc 2001.
4. Duda R.O.& Hart P.E., "Pattern Classification and Scene Analysis", J.wiley Inc, 1973.

# Artificial Intelligence
# Program Elective 4

| MCO 118A | Artificial Neural Network and Deep Learning | 3-0-0 |
|---|---|---|

**Course Objectives**

- To understand the concepts of Artificial neural networks
- To explore in-depth deep neural architectures for learning and inference
- To evaluate the performance of neural architectures in comparison to other machine learning method
- Familiar with the fundamental principles, theory and approaches for learning with deep neural networks
- Discuss Convolution Neural Network models to Applications

| | |
|---|---|
| **UNIT1** | **Introduction to Artificial Neural Network :** Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Type of network architecture, Activation functions, Basic Learning rules |
| **UNIT2** | **Feed forward Networks:** Multilayer Neural Network, Gradient Descent learning, Back propagation, Empirical Risk Minimization, regularization, Radial Basis Neural Network bias-variance trade off, regularization - over fitting - inductive bias regularization - drop out - generalization. |
| **UNIT3** | **Recurrent neural networks**: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs |
| **UNIT4** | **Deep Neural Networks**: Introduction, Difficulty of training deep neural networks, Greedy layer wise training. • Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines. • Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Back propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. • Auto Encoders • Deep Reinforcement Learnin |
| **UNIT 5** | **Convolutional Neural Network**: Basic structure of Convolutional Network, Case studies: Alex net, VGGNet, GoogLeNet, Applications of CNN |

**Course Outcomes**

CO1. Explain the basic concepts in Neural Networks and applications
CO2. Discuss feed forward networks and their training issues
CO3. Distinguish different types of ANN architectures
CO4. Apply fundamental principles, theory and approaches for learning with deep neural networks
CO5. Discuss & Apply Convolution Neural Network models to Applications

| **Course Outcome** | Program Outcome | | | | | | | | | | | | Program Specific Outcome | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO 3 |
| CO1 | M | L | | | | | | | | | | M | | | |
| CO2 | M | L | | | | | | | | | | M | | | |
| CO3 | H | M | M | M | | | | | | | | H | L | M | |
| CO4 | H | M | M | M | M | | | | | | | H | H | H | |
| CO5 | H | M | M | M | M | | | | | | | H | H | H | |

*H = Highly Related; M = Medium ; L = Low*

**Text Books**

1. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006
3. Charu C.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018
4. Satish Kumar, “Neural Networks, A Classroom Approach”, Tata McGraw -Hill, 2007.

| MCO 089B | **Pattern Recognition Lab** | **0-0-2** |
|---|---|---|

**Course Objectives:**

- To introduce the most important concepts, techniques, and algorithms • Assess and understand the challenges behind the design of machine vision systems.
- Understand the general processes of image acquisition, storage, enhancement, segmentation, representation, and description.
- Implement filtering and enhancement algorithms for monochrome as well as color images.

**Course Outcomes:**

CO1. To implement efficient algorithms for nearest neighbour classification, Linear Discriminate Function

CO2. Able to identify the strengths and weaknesses of different types of classifiers & implement them on simple applications.

CO3. Validate and assess and implement different clustering techniques

CO4. Be able to combine various classifiers using fixed rules or trained combiners and boost their performance

CO5. Understand the possibilities and limitations in implementation of pattern recognition techniques to different applications

**Course Contents: Exercises that must be done in this course are listed below:**

Lab 1. Implement a function for extracting the colour histogram of an image.

Lab 2. Read all the images from the training set. For each image compute the colour histogram with general bin size m and save it as a row in the feature matrix X. Save the corresponding class label in the label vector y.

Lab 3. Implement the k-NN classifier for an unknown image and for a general K value. Evaluate the classifier on the test set by calculating the confusion matrix and the overall accuracy.

Lab 4. Try out different values for the number of bins for the histogram and the parameter K to see which feature attains the best performance. Convert the input image into Luv or HSV color-space before histogram calculation.

Lab 5. Data visualization, central limit theorem, multivariate normal distribution, data whitening, non-parametric

Lab 6. Implement Hierarchical clustering, k-means, fuzzy c-means

Lab 7. Implementation of Bayesian classifier, k-NN classifier

Lab 8. Linear regression, MMSE, MAP, MLE, quality measures

Lab 9. Apply various dimensionality reduction methods whether through feature selection or feature extraction. Assess classifier complexity and regularization parameters

Lab 10. Combine various classifiers using fixed rules or trained combiners and boost their performance using some test data set from real world

| MCO 120A | Artificial Neural Network and Deep Learning Lab | 0-0-2 |
|---|---|---|

**Course Objectives**:

At the end of the course

- The students should be able to design and implement machine learning solutions
- Understand classification, regression, and clustering problems;
- Able to evaluate and interpret the results of the algorithms.

**Course Outcomes:**

CO1. Create a custom feed-forward network.

CO2. Design Constructing Layers and Setting Transfer Functions

CO3. Implement Discriminative Learning models: Logistic Regression, Perceptrons, Artificial Neural Networks.

**List of Experiments**

Lab 1. Create a custom feed-forward network .It consists of the following sections:

Constructing Layers , Connecting Layers , Setting Transfer Functions, Weights and Biases , Training Functions & Parameters , Performance Functions , Train Parameters

Lab 2. Write a program to plot various membership functions.

Lab 3. Generate AND, NOT function using McCulloch-Pitts neural net program.

Lab 4. Generate XOR function using McCulloch-Pitts neural net.

Lab 5. Write a program for Perceptron net for an AND function with bipolar inputs and targets

Lab 6. Write a program of Perceptron Training Algorithm

Lab 7. Write a program of Back Propagation Algorithm.

Lab 8. Implement ANN and compare , regularization, overfitting, underfitting and drop out

**Lab 9.** Implement Convolutional Neural Networks (CNNs) and overcome overfitting with dropout.

**Lab 10.** Implement Convolutional Neural Networks (CNNs) for Object detection

# Artificial Intelligence
# Program Elective 5

| MCO 121A | Application of Artificial Intelligence in Industries | 3-0-0 |
|---|---|---|

**Course Objectives**

- Able to apply the concept of Artificial intelligence in various sectors
- Familiarize with applications of Artificial intelligence in banking applications.
- Appreciate the various applications in Communication and Education Industry.
- Identify the applications in Health care and Government sectors.
- Recognize the applications in Manufacturing industry and Transportations.

| | |
|---|---|
| Module 1: | **AI in Banking :** Use of AI in banking and finance, Fraud detection, , Risk modeling and investment banks, Customer data management, Decreased customer experience and loyalty, Personalized marketing, Role of machine learning: Challenges of banking sector and securities, Widely used machine learning algorithms in banking and security, Fraud prevention and detection systems, Rule based and machine learning based approach in fraud detection, Anomaly detection: Ways to expose suspicious transactions in banks, Advanced fraud detection systems, Risk management systems, Current challenges and opportunities: Banking and security domain. |
| Module 2: | **AI in Communication, Media & Healthcare:** Usage of AI in media and entertainment industry, Machine learning techniques for customer sentiment analysis, Real-time analytics in communication, Real time analytics and social media, Recommendations engines. The most important applications of machine learning in healthcare, Role of machine learning in drug discovery, Medical image analysis, Why deep learning for medical image analysis and Predictive medicine: Prognosis and diagnostics accuracy, Predictive medicine |
| Module 3: | **AI in Education & Manufacturing:** Advantages of AI in education, learning analytics, Academic analytics, Action research, Educational data mining, Personalized adaptive learning, Learning analytics process, Case study: Application of ML in predicting students' performance.<br>Applications in manufacturing industry, Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, Case study, Construction of CNN, Experimental results, Efficiency of CNN for defect detection, Comparative experiments, Machine learning for fault assessment, Machinery failure prevention technology. |

| | |
|---|---|
| Module 4: | **AI in Government Administration:** Type of government problems appropriate for AI applications, AI for citizen services use cases, Answering questions, Routing requests, Translation, Drafting documents, Chat bots for communication between citizen and government, Media richness theory, Chatbots in the public sector, Case study, Data management services, Knowledge processing services, Application services. |
| Module 5: | **AI in Transportation & Energy Sector:** Applications of ML and artificial intelligence in transportation, Incident detection, Predictive models, Application of AI in aviation and public transportation, Aviation, Shared mobility, Buses, Intelligent urban mobility, Autonomous vehicles, Autonomous transportation, Artificial intelligence use cases in logistics, Back office AI, Cognitive customs, Predictive logistics, Predictive risk management, Seeing thinking and speaking logistics operations, ML powered customer experience, Limitations of AI techniques in transportation,<br>AI in Smart grid technologies, Key characteristics of smart grid, Machine learning applications in smart grid, Machine learning techniques for renewable energy generation, Forecasting etc Case studies |

**Course Outcomes**

CO1. Familiarize, compare and analyze the role of AI in banking applications
CO2. Analyze the applications in Media and Health care Industry
CO3. Appreciate the various applications in manufacturing industry and Education sectors.
CO4. Identify the problems in public sectors and role of AI in the solutions
CO5. Recognize the applications and challenges in Transportation and Energy Sectors

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | M | | | H | | | | | | | H | H | H | |
| CO2 | H | H | | | H | M | | | | | | H | H | H | H |
| CO3 | H | H | | | H | M | | | | | | H | H | H | H |
| CO4 | H | H | | | H | | | | | | | H | M | M | |
| CO5 | H | H | | | H | | | | | | | H | M | M | |

*TEXT BOOK*

1. David Beyer, Artificial Intelligence and Machine Learning in Industry,: O'Reilly Media, Inc.,ISBN: 9781491959336

2. Doug Hudgeon, Richard Nichol, Machine Learning for Business **, D**ecember 2019 , ISBN 9781617295836
3. Application of machine learning in industries (IBM ICE Publications).
4. Andreas François Vermeulen, “Industrial Machine Learning”, Apress, Berkeley, CA,2020

H = Highly Related; M = Medium; L = Low

# Cloud Computing Track

## Cloud Computing
## Program Elective 1

| MCO 024B | Grid Computing | 3-0-0 |
|---|---|---|

**Objective: The objectives of this course are to:**

1. Introduce a thorough understanding of Grid Computing concepts and how these can be applied in cloud computing.
2. Discuss and understand the Architecture and Applications of Grid Computing.
3. Develop the understanding of designing Grid Computing enabled software applications.

| | |
|---|---|
| **UNIT** 1: | **Grid Computing**: values and risks – History of Grid computing, Grid computing model and protocols, Overview and types of Grids. |
| **UNIT** 2: | **Desktop Grids** : Background, Definition, Challenges, Technology, Suitability, Grid server and practical uses, Clusters and Cluster Grids, HPC Grids, Scientific in sight, Application and Architecture, HPC application, Development Environment and HPC Grids, Data Grids, Alternatives to Data Grid, Data Grid architecture. |
| **UNIT** 3: | **The open Grid services Architecture**, Analogy, Evolution, Overview, Building on the OGSA platform, Implementing OGSA based Grids, Creating and Managing services, Services and the Grid, Service Discovery, Tools and Toolkits, Universal Description Discovery and Integration . |
| **UNIT** 4: | **Desktop Supercomputing**, Parallel Computing, Parallel Programming Paradigms, Problems of Current parallel Programming Paradigms, Desktop Supercomputing Programming Paradigms, Parallelizing Existing Applications, Grid Enabling Software Applications, Needs of the Grid users, methods of Grid Deployment, Requirements for Grid enabling Software, Grid Enabling Software Applications. |
| **UNIT** 5: | Application integration, Application classification, Grid requirements, Integrating applications with Middleware platforms, Grid enabling Network services, Managing Grid environments, Managing Grids, Management reporting, Monitoring, Data catalogs and replica management, Portals, Different application areas of Grid computing. |

**Course outcomes:**

At the end of the course, the student should be able to:

CO1. Compare modern concepts of Grid Computing.
CO2. Analyse and understand the challenges in creating and managing Grid service Architecture.
CO3. Build understanding of parallel and supercomputing programming paradigms.
CO4. Integrate applications with middleware platforms.

***Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:***

| *Course Outcome* | *Program Outcome* | | | | | | | | | | | *Program Specific Outcome* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | H | H | M | | | | | | *L* | | | | H | | |
| *CO2* | | | | H | | | M | | | | | H | | H | |
| *CO3* | | H | | | | | H | | | H | | | *H* | | H |
| *CO4* | | H | | | | | H | L | | | | | | | H |

*H = Highly Related; M = Medium L = Low*

**Text Books**:

1. Ahmar Abbas, "Grid Computing: A Practical Guide to Technology and Applications",Firewall Media, 2004.

**Reference Books:**

1. Joshy Joseph and Craig Fellenstein, "Grid Computing", Pearson Education, 2001.
2. Ian Foster and Carl Kesselman, "Grid Blue Print for New Computing Infrastructure", Morgan Kaufmann, 2000.
3. Fran Berman, Geoffrey Fox and Anthony J. G. Hey, "Grid Computing: Making the Global Infrastructure a Reality", Willy Publisher, 2001

## Cloud Computing

## Program Elective 1

| MCO 104B | **Cloud Security: Course Outlines** | **3-0-0** |
|---|---|---|

**Objective: The objectives of this course are to:**

1. Introduce a thorough understanding of cloud security concepts and how these can be applied in the cloud computing.
2. Discuss and understand the legal and compliance issues for cloud provider and compliance for the cloud consumer.
3. Develop the understanding in designing backup/recovery, data replication solutions and tools that will serve to build, configure, protect, troubleshoot and manage the virtual resources in virtual environment.

| | |
|---|---|
| **Unit I** | SECURITY CONCEPTS: Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL. |
| **Unit II** | MULTI-TENANCY ISSUES: Isolation of users/VMs from each other. How the cloud provider can provide this; Virtualization System Security Issues- e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery; Virtualization System Vulnerabilities- Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc). |
| **Unit III** | VIRTUALIZATION SYSTEM-SPECIFIC ATTACKS: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking. |
| **Unit IV** | TECHNOLOGIES FOR VIRTUALIZATION-BASED SECURITY ENHANCEMENT: IBM security virtual server protection, virtualization-based sandboxing; Storage Security- HIDPS, log management, Data Loss Prevention. Location of the Perimeter. |
| **Unit V** | LEGAL AND COMPLIANCE ISSUES: Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer. |

**Course outcomes:**

At the end of the course, the student should be able to:

CO5. Compare modern security concepts as they are applied to cloud computing

CO6. Assess the security of virtual systems.

CO7. Evaluate the security issues related to multi-tenancy,

CO8. Appraise compliance issues that arise from cloud computing

***Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | H | H | M | | | | | | *L* | | | | H | | |
| *CO2* | | | | H | | | M | | | | | H | | H | |
| *CO3* | | | | | M | | | | | L | H | | M | | H |
| *CO4* | | H | | | | | H | L | | | | | | | H |

*H = Highly Related; M = Medium L = Low*

***Text Book:***

1. Cloud Security: A Comprehensive guide to secure cloud computing by Ronald L. Krutz and Russell Dean Vines

***References:***

*2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876], 2010.*
*3. John Rittinghouse, James Ransome, "Cloud Computing" CRC Press; 1 edition [ISBN: 1439806802], 2009.*
*4. J.R. ("Vic") Winkler, "Securing the Cloud" Syngress [ISBN: 1597495921] 2011. 12 SRM-M.Tech Cloud Computing 2015 – 16*
*7. Cloud Security Alliance 2010, "Top Threats to Cloud Computing" Microsoft 2013.*
*8. Timothy Grance; Wayne Jansen;NIST "Guidelines on Security and Privacy in Public Cloud Computing", 2011.*

**Cloud Computing**
**Program Elective 2**

| MCO 105A | **Managing Virtual Environment: Course Outlines** | **3-0-0** |
|---|---|---|

**Objective: The objectives of this course are to:**

1. Familiarize student about the role and applications of virtual environment in cloud computing.
2. Incorporate the knowledge of advanced technologies to configure, manage and secure virtual resources.
3. Develop the concepts and tools that will serve to build, configure, protect, troubleshoot and manage the virtual resources in virtual environment.

| | |
|---|---|
| **UNIT I** | PERFORMANCE MANAGEMENT IN A VIRTUAL ENVIRONMENT : Management techniques, methodology and key performance metrics used to identifying CPU, memory, network, virtual machine and application performance bottlenecks in a virtualized environment. |
| **UNIT II** | CONFIGURATION AND CHANGE MANAGEMENT : Configuration and change management goals and guidelines, tools and technologies in virtualized environments |
| **UNIT III** | SECURE VIRTUAL NETWORKING : Configuration and change management goals and guidelines, tools and technologies in virtualized environments; Virtual network security architecture, network segmentation and traffic isolation to secure a virtual network configuration |
| **UNIT IV** | PROTECTING THE MANAGEMENT ENVIRONMENT: Server authentication, authorization, and accounting, SSL certificates, server hardening; Protecting the host system: security architecture, controlling access to storage, hardening hosts, Hardening virtual machines; Virtual machine security architecture, security parameters; Protecting the host and virtual machine systems using server authentication, authorization, and accounting techniques. |
| **UNIT V** | TROUBLESHOOTING VIRTUAL ENVIRONMENTS: Interpreting host, network, storage, cluster and virtual machine log files. Network troubleshooting, traffic sniffing, storage access problems, iSCSI authentication and digests. Virtual machine migration, cluster errors with shares, pools, and limits; Command line interfaces and syntax, interpreting host, network, storage, cluster, virtual machine log files and network traces. |

**Course Outcomes:** Through this course students should be able to:

CO1: Identify and explain basic concepts and key performance matrices of virtualized computing resources.
CO2: Build understanding of statistics involved in virtual network security architecture and its configuration.
CO3: Formulate the core issues in troubleshooting and protecting virtual environment such as authentication, 10 authorization, privacy, and interoperability.
CO4: Solve common problems that can be encountered during virtual machine and virtual storage migration.

***Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | | | | | H | | | *L* | | | *M* | *M* | | *L* | |
| *CO2* | | H | | | | M | H | | | | | | H | | H |
| *CO3* | | | | H | | | | | | H | | | | | *M* |
| *CO4* | H | | H | | M | | | | M | | | | *H* | H | |

*H = Highly Related; M = Medium L = Low*

**Text books:**

1. Massimo Cafaro (Editor), Giovanni Aloisio (Editor), "Grids, Clouds and Virtualization" Springer; edition [ISBN: 978-0857290489] 2011.
2. Chris Wolf and Erick M. Halter, "Virtualization" A press; 1 edition [ISBN: 978-1590594957] 2005.

**Reference books:**

3. Gaurav Somani, "Scheduling and Isolation in Virtualization", VDM Verlag Dr. Müller [ISBN: 978-3639295139], Muller Publishers, Germany, Sept. 2010
4. LatifaBoursas (Editor), Mark Carlson (Editor), Wolfgang Hommel (Editor), Michelle Sibilla (Editor), KesWold (Editor), "Systems and Virtualization Management: Standards and New Technologies" [ISBN: 978-3540887072], October 14, 2008
5. Edward L. Haletky, "VMware ESX Server in the enterprise" [ISBN: 978- 0132302074]. Prentice Hall; 1 edition 29 Dec 2007.
6. Edward Haletky, "VMware ESX and ESXi in the Enterprise - Planning Deployment of Virtualization Servers" [ISBN: 978-0137058976]., Prentice Hall; 2 edition February 18, 2011.

**Cloud Computing**
**Program Elective 3**

| MCO 102A | Cloud Storage Infrastructure: Course Outlines | 3-0-0 |
|---|---|---|

**Objective: The objectives of this course are to:**

1. Incorporat a thorough understanding of virtualized data-center architecture, services, interface, and environment in student.
2. Familiarize student about the security regulations and governance in designing secure storage in virtualized and cloud environment.
3. Develop the understanding in designing backup/recovery, data replication solutions and tools that will serve to build, configure, protect, troubleshoot and manage the virtual resources in virtual environment.

| | |
|---|---|
| **UNIT I** | 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 II** | INFORMATION STORAGE SECURITY & DESIGN: Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM. |
| **UNIT III** | 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 IV** | OPTIMIZATION OF CLOUD STORAGE: Global storage management locations, scalability, operational efficiency. Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attitudes; file systems or object storage. |
| **UNIT V** | INFORMATION AVAILABILITY DESIGN: Designing backup/recovery solutions to guarantee data availability in a virtualized environment. Design a replication solution, local remote and advanced. Investigate Replication in NAS and SAN environments. Data archiving solutions; analyzing compliance and archiving design considerations. |

**Outcomes:**

At the end of the course, the student should be able to:

CO1. Identify the philosophy, architecture, and practical use of virtualized data-center in cloud computing environment.

CO2. Present fundamental skills, and techniques in optimization of cloud storage.

CO3. Solve common problems that can be encountered during design and setup of backup/recovery and replication solutions virtualized environment.

CO4. Build understanding of key privacy concerns in storage strategy and governance, security and regulations in cloud security management.

1. **Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:**

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | | | | L | H | M | | | | | *M* | | | M | |
| *CO2* | | | H | | | | | | H | | | | | | L |
| *CO3* | H | | H | | | | | | | | | M | M | H | M |
| *CO4* | | H | | | | | H | | | H | | | *H* | | H |

*H = Highly Related; M = Medium L = Low*

**Cloud Computing**
**Program Elective 4**

| MCO 011A | Cloud Computing: Course Outlines | 3-0-2 |
|---|---|---|

**Course Objective:**

5. To familiarize the philosophy, power, practical use of cloud.
6. To introduce fundamental principles, technology, and techniques of CC
7. To Discuss common problems that can be best solved with/in cloud
8. To Eliminate misconceptions about cloud computing

| | |
|---|---|
| Module 1: | Understanding cloud computing: Introduction to Cloud Computing - Benefits and Drawbacks - Types of Cloud Service Development - Deployment models |
| Module 2: | Cloud Architecture Technology and Architectural Requirements: The Business Case for Clouds - Hardware and Infrastructure – Accessing the cloud – Cloud Storage – Standards- Software as a Service – Discovering Cloud Services Development tools. Three Layered Architectural Requirement - Provider Requirements |
| Module 3: | Service Centric Issues - Interoperability - QoS - Fault Tolerance - Data Management Storage and Processing - Virtualization Management - Scalability - Load Balancing - Cloud Deployment for Enterprises - User Requirement - Comparative Analysis of Requirement. |
| Module 4: | Security Management in Cloud: Security Management Standards - Security Management in the Cloud Availability Management - SaaS Availability Management - PaaS Availability Management - IaaS Availability Management - Access Control - Security Vulnerability, Patch, and Configuration Management – Privacy in Cloud- The Key Privacy Concerns in the Cloud - Security in Cloud Computing. |
| Module 5: | Virtualization: Objectives - Benefits - Virtualization Technologies - Data Storage Virtualization – Storage Virtualization – Improving Availability using Virtualization - Improving Performance using Virtualization- Improving Capacity using Virtualization. |

**Outcomes:**

At the end of the course, the student should be able to:

CO1: Identify the philosophy, power, and practical use of cloud.

CO2: Present fundamental principles, technology, and techniques of CC

CO3: Solve common problems that can be encountered during setup of virtual server and storage.

CO4: Build understanding of key privacy concerns in cloud security management.

***Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | H | | L | | H | | | | | | | *M* | | | L |
| *CO2* | | | | | | | | | H | | L | | H | L | |
| *CO3* | | | H | | | | | | | | | | | H | *H* |
| *CO4* | | H | | | | M | H | | | | | | *H* | | |

*H = Highly Related; M = Medium L = Low*

**Text books:**

1. David S Linthicum, "Cloud Computing and SOA Convergence in your Enterprise A Step by Step Guide", Addison Wesley Information Technology Series.
2. Anthony T Velte, Toby J.Velte, Robert Elsenpeter, "Cloud computing A Practical Approach ", Tata McGraw Hill Publication

**References:**


1. Tim Mather, Subra Kumara swamy, Shahed Latif, "Cloud Security and Privacy –
2. An Enterprise Perspective on Risks and Compliance" , O'Reilly Publications, First Edition
3. Michael Miller, "Cloud Computing – Web-Based Applications that Change the Way You Work and Collaborate Online", Pearson Education, New Delhi, 2009.
4. Cloud Computing Specialist Certification Kit – Virtualization Study Guide.

**Cloud Computing**
**Program Elective 5**

| | | |
|---|---|---|
| MCO 114B | **Design and Development of Cloud Application: Course Outlines** | **3-0-2** |

**Objective: The objectives of this course are to:**

1. Incorporate the knowledge of functional design, tools and technology decisions in developing cloud applications.
2. Describe the working of third party APIs and their interconnectivity in cloud ecosystems.
3. Develop the conceptual thinking in designing Use Case to develop and deploy an advanced cloud application using framework and platform of choice to demonstrate an understanding of database,

| | |
|---|---|
| **UNIT 1** | DESIGNING CLOUD BASED APPLICATIONS: Role of business analyst, requirements gathering, UML, use of state diagrams, wire frame prototypes, use of design tools such as Balsamiq. Selecting front end technologies and standards, Impact of growth in mobile computing on functional design and technology decisions |
| **UNIT 2** | CLOUD APPLICATION DEVELOPMENT: Technical architecture considerations – concurrency, speed and unpredictable loads. Agile development, team composition (including roles/responsibilities), working with changing requirements and aggressive schedules. Understanding Model View Controller (MVC). Advanced understanding of "views", location, and the presentation layer: Advanced Ajax and JQuery. Presenting to different browsers and devices. Localization and internationalization; Understanding client location and device type. Mobile application development – Android, iOS, WP, RIM, Symbian |
| **UNIT 3** | STORING OBJECTS IN THE CLOUD Session management. Advanced database techniques using MySQL and SQL Server, blob storage, table storage. Working with Third Party APIs: Overview of interconnectivity in cloud ecosystems. Working with Twitter API, Flickr API, Google Maps API. Advanced use of JSON and REST. |
| **UNIT 4** | CLOUD APPLICATIONS AND SECURITY ISSUES: Understanding cloud based security issues and threats (SQL query injections, common hacking efforts), SSL, encrypted query strings, using encryption in the database. Authentication and identity. Use of oAuth. OpenID; Understanding QA and Support: Common support issues with cloud apps: user names and passwords, automated emails and spam, browser variants and configurations. Role of developers in QA cycle. QA techniques and technologies. Use of support forums, trouble ticketing. |
| **UNIT 5** | USE CASES: Design, develop and deploy an advanced cloud app using framework and platform of choice to demonstrate an understanding of database, presentation and logic. Application should demonstrate integration with third party API, sensitivity to geography of user (language, currency, time and date format), authentication of user, security, and awareness of client device/browser. Case Studies: Salesforce, Basecamp, Xero.com, Dropbox |

**Course outcomes:**

At the end of the course, the student should be able to:

CO1 : Design and develop MVC inspired cloud based application.

CO2 : Assess the security issues and threat using encryption in cloud based database.

CO3 : Demonstrate the integration of cloud application of with third party API.

CO4 : Compare different architecture, frameworks and modern technologies in cloud based application development.

***Mapping course outcomes leading to the achievement of program outcomes and program specific outcomes:***

| ***Course Outcome*** | *Program Outcome* | | | | | | | | | | | | *Program Specific Outcome* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | PO8 | PO9 | PO10 | PO11 | PO12 | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | H | L | | | H | H | | | | | | | H | *L* | H |
| *CO2* | | | M | | M | | H | | | | | | | *H* | |
| *CO3* | | | | | | | | | H | L | | M | H | | M |
| *CO4* | | | | H | | | | | | | H | | | H | |

*H = Highly Related; M = Medium L = Low*

**Text**:

1. Jim Webber, Savas Parastatidis, Ian Robinson, "REST in Practice" O'Reilly Media; 1 edition, [ISBN: 978-0596805821] 2010.

**Reference:**

1. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, MatiasWoloski, "Developing Applications for the Cloud on the Microsoft Windows Azure Platform" Microsoft Press; 1 edition, [ISBN: 9780735656062] 2010.
2. Dan Wellman, "jQuery UI 1.6" Packt Publishing [ISBN: 9781847195128] 2009.
3. Peter Lubbers, Brian Albers, Frank Salem, Ric Smith, "Pro HTML5 Programming" A

# Data Analytics Track

**Data Analytics**
**Program Elective 1**

| MCO 127A | **Advance Data Mining** | **3-0-0** |
|---|---|---|

**Pre-requisite** NIL

**Course Objectives**

1. Study the sequential patterns algorithms
2. Study the patterns from time series data.
3. Study the Temporal Patterns algorithms
4. Analysis of computing frameworks for Big Data analytics.

## Syllabus

| | |
|---|---|
| Unit 1 | Sequential Pattern Mining concepts, primitives, scalable methods; Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis; |
| Unit 2 | Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification ofdynamic data streams, Class Imbalance Problem; Graph Mining, Mining frequent subgraphs,finding clusters, hub and outliers in large graphs, Graph Partitioning; |
| Unit 3 | Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; |
| Unit 4 | Distributed Data Mining,Distribute data mining framework, Distributed data source, Distributed data mining techniques,Distributed classifier learning, distributed clustering, distributed association rule mining and Challenges of distributed data mining; |
| Unit 5 | Social Network Analysis, characteristics of social Networks. |

**Course Outcomes:** At the end of the course the student will be able to:

CO1 Analyze Algorithms for sequential patterns.
CO2 Extract patterns from time series data.
CO3 Develop algorithms for Temporal Patterns.
CO4 Identify computing frameworks for Big Data analytics.
CO5 Extend the Graph mining algorithms to Web Mining.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | | **Program Specific Outcome** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* | *PO12* | *PSO1* | *PSO2* | *PSO3* |
| *CO1* | | *L* | | | | | | | | | *L* | | *L* | | |
| *CO2* | *L* | *L* | | *L* | *L* | *M* | | | | *L* | | | *M* | | |
| *CO3* | | | | | | | | | | | *M* | | *M* | *L* | |
| *CO4* | *M* | | | | | *L* | | | | | *M* | | | | *L* |
| *CO5* | *L* | *M* | | | | *M* | | | | | | *L* | | | |

*H = Highly Related; M = Medium L = Low*

***Text Book & Reference Books:***

*1. Jiawei Han and M Kamber , Data Mining Concepts and Techniques, , Second Edition, Elsevier Publication, 2011.*
*2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.*
*3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.*
*4. Research Papers*

**Data Analytics**
**Program Elective 2**

| MCO 122A | Domain Specific Predictive Analytics | 3-0-0 |
|---|---|---|

**Pre-requisite NIL**

**Course Objectives**

1. It introduces theoretical foundations, algorithms, methodologies for analysing data in various domains such Retail, Finance, Risk and Healthcare.

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|---|---|
| UNIT 1 | **Retail Analytics** Understanding Customer Profiling and Segmentation, Modelling Churn. Modelling Lifetime Value, Modelling Risk, Market Basket Analysis.<br>**Risk Analytics** Risk Management and Operational Hedging An Overview, Supply Chain Risk Management, A Bayesian Framework for Supply Chain Risk Management, Credit Scoring and Bankruptcy Prediction |
| **UNIT 2** | **Financial Data Analytics** Financial News analytics Framework, techniques, and metrics, News events impact market sentiment, Relating news analytics to stock returns<br>**Financial Time Series Analytics** Financial Time Series and Their Characteristics, Common Financial Time Series models, Autoregressive models, Markov chain models, Time series models with leading indicators, Long term forecasting |
| **UNIT 3** | **Introduction HealthcareAnalytics** An Introduction to Healthcare Data Analytics, Electronic Health Records, Privacy-Preserving Data Publishing Methods in Healthcare, Clinical Decision Support Systems |
| **UNIT 4** | **Healthcare Data Analytics** Natural Language Processing and Data Mining for Clinical Text Core NLP Components, Information Extraction and Named Entity Recognition, Social Media Analytics for Healthcare Tracking of Infectious Disease Outbreaks, Readmission risk Prediction |
| **UNIT 5** | **Genomic Data Analytics** Microarray Data, Microarray Data Analysis, Genomic Data Analysis for Personalized Medicine, Patient Survival Prediction from Gene Expression Data, Genome Sequence Analysis |

**Course Outcome**

CO1.Recognize challenges in dealing with data sets in domains such as finance, risk and healthcare.
CO2. Identify real-world applications of machine learning in domains such as finance, risk and healthcare.
CO3.Identify and apply appropriate algorithms for analyzing the data for variety of problems in finance, risk and healthcare.
CO4.Make choices for a model for new machine learning tasks based on reasoned argument
CO5: Introduce the principles and methodologies used in genomic data analytics, with a focus on microarray data and its applications.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | L | | L | | | | | | | | M | M | | L | |
| CO2 | L | | M | | | L | | | | | M | L | M | | |
| CO3 | | M | | | | | | | | | M | L | | | L |
| CO4 | | M | M | | H | L | | | | | L | L | | L | |
| CO5 | M | M | | | H | L | | | | | M | | M | M | |

H = Highly Related; M = Medium L = Low

**Text Book(s)**

1. Chris Chapman, Elea McDonnell Feit "R for Marketing Research and Analytics", Springer, 2015.
2. Olivia Parr Rud “Data Mining Cookbook Modeling Data for Marketing, Risk, and Customer Relationship Management”, Wiley, 2001.
3. Chandan K. Reddy, Charu C. Aggarwal "Healthcare Data Analytics", CRC Press, 2015.
4. Rene Carmona "Statistical Analysis of Financial Data in R", Springer, 2014.
5. James B. Ayers “Handbook Of Supply Chain Management” Auerbach Publications, 2006.
6. PanosKouvelis, Lingxiu Dong, OnurBoyabatli, Rong Li "The Handbook of Integrated Risk Management in Global Supply Chains", Wiley, 2012.

**Data Analytics**
**Program Elective 2**

| MCO 123A | Exploratory Data Analysis | 3-0-0 |
|---|---|---|

**Course Objectives**

1.This course introduces the methods for data preparation and data understanding.
2.It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.
3.Supports to Summarize the insurers use of predictive analytics, data science and Data Visualization

| | |
|---|---|
| **UNIT 1** | **Introduction To Exploratory Data Analysis:** Data Analytics lifecycle,Exploratory Data Analysis(EDA) Definition, Motivation, Stepsindataexploration, The basic data types Data Type Portability |
| **UNIT 2** | **Preprocessing-Traditional Methods And Maximum Likelihood Estimation** Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, Improving the accuracy of analysis<br>**Preprocessing Bayesian Estimation** Introduction to Bayesian Estimation ,Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data |
| **UNIT 3** | **Data Summarization & Visualization**<br>Statistical data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, ND Statistical data analysis |
| **UNIT 4** | **Outlier Analysis**<br>Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density Based outlier analysis, Outlier Detection in Categorical Data |
| **UNIT 5** | **Feature Subset Selection** Feature selection algorithms filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features election<br>**Dimensionality Reduction** Introduction, Principal Component Analysis(PCA), Kernel PCA, Canonical Correlation Analysis, Factor Analysis, Multi dimensional scaling, Correspondence Analysis |

**Course Outcome**

CO1.Handle missing data in the real world data sets by choosing appropriate methods.
CO2.Summarize the data using basic statistics. Visualize the data using basic graphs and plots. CO3.Identify the outliers if any in the data set.
CO4.Choose appropriate feature selection and dimensionality reduction
CO5.Techniques for handling multi-dimensional data

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | L | | | | | | | | | | | L | | | L |
| CO2 | | L | | | M | | | | | | | L | | L | |
| CO3 | L | | | | | L | | | | | | M | | | |
| CO4 | | L | | | M | | | | | | | L | | L | |
| CO5 | | | | | | L | | | | | | L | | | |

H = Highly Related; M = Medium L = Low

**Reference Books**


1. Charu C. Aggarwal ,“Data Mining The Text book”, Springer, 2015.

2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.

3. Inge Koch, “Analysis of Multivariate and High dimensional data”, Cambridge University Press, 2014.

4. Michael Jambu, “Exploratory and multivariate data analysis”, Academic Press Inc. , 1990.

5. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC press, 2015

**Data Analytics**
**Program Elective 3**

| MCO 124A | BIG DATA FRAMEWORKS | 3-0-1 |
|---|---|---|

**Pre-requisite** NIL

**Course Objectives**

1. To understand the need of Big Data, challenges and different analytical architectures
2. Installation and understanding of Hadoop Architecture and its ecosystems
3. Processing of Big Data with Advanced architectures like Spark.
4. Describe graphs and streaming data in Spark Expected

| | |
|---|---|
| **UNIT 1** | **Introduction To Big Data** Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks |
| **UNIT 2** | **Hadoop Framework -** Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with other system - Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs |
| **UNIT 3** | **Hadoop Ecosystem** Introduction to Hadoop ecosystem technologies Serialization AVRO, Co-ordination Zookeeper, Databases HBase, Hive, Scripting language Pig, Streaming Flink, Storm |
| **UNIT 4** | **Spark Framework**<br>Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features<br>**Data Analysis with Spark Shell** Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution |
| **UNIT 5** | **Spark SQL and GraphX** SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms<br>**Spark Streaming** Overview – Errors and Recovery – Streaming Source – Streaming live data with spark |

**Course Outcome**

1. Discuss the challenges and their solutions in Big Data
2. Understand and work on Hadoop Framework and eco systems and Explain and Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.
3. Demonstrate spark programming with different programming languages.
4. Demonstrate the graph algorithms and live streaming data in Spark
5. Analyse and implement different frame work tools by taking sample data sets.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | L | | | L | L | M | | | | L | | L | L | | |
| CO2 | | | | | | M | | | | | M | | L | L | |
| CO3 | M | L | | | | | | | | | H | | L | | L |
| CO4 | | L | | | | L | | | | | M | | L | | |
| CO5 | L | M | | | | | | | | | L | | M | | |

H = Highly Related; M = Medium L = Low

**Text Book & Reference Books**


1. Mike Frampton, “Mastering Apache Spark”, Packt Publishing, 2015.
2. TomWhite,“Hadoop TheDefinitiveGuide”,O’Reilly,4thEdition,2015.
3. NickPentreath,MachineLearningwithSpark,PacktPublishing,2015.
4. Mohammed Guller, Big Data Analytics with Spark, Apress,2015
5. Donald Miner, Adam Shook, “Map Reduce Design Pattern”, O’Reilly, 2012

| | Program Lab – 3 BIG DATA FRAMEWORKS LAB | 0-0-2 |
|---|---|---|

**1.** (i) Perform setting up and Installing Hadoop in its two operating modes

- Pseudo distributed,
- Fully distributed.

(ii) Use web based tools to monitor your Hadoop setup.

**2.** (i) Implement the following file management tasks in Hadoop

- Adding files and directories
- Retrieving files
- Deleting files

(ii) Benchmark and stress test an Apache Hadoop cluster

**3.** Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

- Find the number of occurrence of each word appearing in the input file(s)
- Performing a MapReduce Job for word search count (look for specific keywords in a file)

**4.** Stop word elimination problem

- Input
  - A large textual file containing one sentence per line
  - A small file containing a set of stop words (One stop word per line)
- Output
  - A textual file containing the same sentences of the large input file without the words appearing in the small file.

**Data Analytics**
**Program Elective 4**

| MCO 125A | Advance Python Programming for Data Analytics | 3-0-1 |
|---|---|---|

**Prerequisites**
Basic Knowledge of Python Programming

**Course Objectives**
The course should enable the students

1. Describe the semantics of Python programming language and Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.
2. llustrate the Object-oriented Programming concepts in Python.
3. Demonstrate the basic database design for storing data as part of a multi-step data gathering, analysis, and processing.
4. Familiarize the basics of machine learning using an approachable, and also understand the advantage of using Python libraries for implementing Machine Learning models.

**SYLLABUS**

| | |
|---|---|
| **UNIT-1** | **Introduction to Python,** use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries |
| **UNIT-2** | **Classes in Python** OOPS Concepts, Classes and objects , Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators. |
| **UNIT-3** | **I/O and Error Handling In Python** Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories. |
| **UNIT-4** | **An Introduction to relational databases** SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, Creating a GUI that handles an event, working with components. |
| **UNIT-5** | **Implement Machine Learning algorthims** Usage of Numpy for numerical Data,Usage of Pandas for Data Analysis, Matplotlib for Python plotting, Seaborn for Statical plots, interactive Dynamic visualizations, SciKit for Machine learning. |

**Course Outcomes**

CO1 Interpret the basic principles of Python programming language
CO2 Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python
CO3 Identify the commonly used operations involving file systems and regular expressions.
CO4 Implement database and GUI applications
CO5 Implement Machine Learning algorithms

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | L | | | | | L | | | | | L | M | | L | |
| CO2 | L | | L | | | | | | | | L | | | M | |
| CO3 | L | | M | | | L | | | | | L | | L | | |
| CO4 | L | | L | | | | | | | | L | | | | |
| CO5 | L | | H | H | | | | | | | L | | | L | |

H = Highly Related; M = Medium L = Low

**TEXT BOOKS**

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016

2. Haltermanpython

3.Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010

**ONLINE RESOURCES**

https //www.w3schools.com/python

https //docs.python.org/3/tutorial/index.html

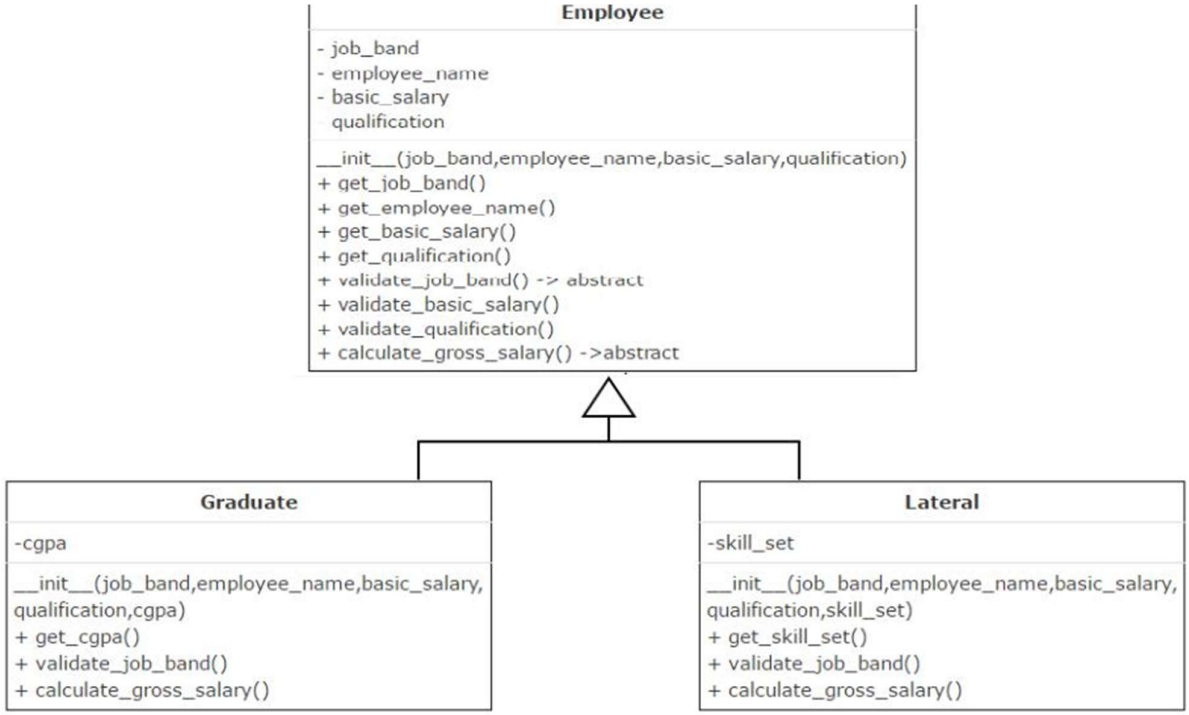
https  //www.python-course.eu/advanced_topics.php

| | | |
|---|---|---|
| | **Program Lab – 4 - Advanced Python Programming LAB** | **0-0-2** |

1. Write a python function which accepts a sentence and returns a list in which first value is the count of upper case letters and second value is the count of lower case letters in the sentence. Ignore spaces, numbers and other special characters if any.

2. WeCare insurance company wants to calculate premium of vehicles. Vehicles are of two types – "Two Wheeler" and "Four Wheeler". Each vehicle is identified by vehicle id, type, cost and premium amount. Premium amount is 2% of the vehicle cost for two wheelers and 6% of the vehicle cost for four wheelers. Calculate the premium amount and display the vehicle details

3. Soft Systems Ltd is a private firm that provides software solutions to its customers.40 min The management wants to calculate salary for the employees. There are two types of employees namely graduates who are in probation period and laterals who are experienced joiners in the company. Write a python program based on the class diagram given below




4. Retrieve and process some data and then use the Google Maps API to visualize our data.

5. Fred is a very predictable man. For instance, when he uses his laptop, all he does is watch TV shows. He keeps on watching TV shows until his battery dies. Also, he is a very meticulous man, i.e. he pays great attention to minute details. He has been keeping logs of every time he charged his laptop, which includes how long he charged his laptop for and after that how long was he able to watch the TV. Now, Fred wants to use this log to predict how long will he be able to watch TV for when he starts so that he can plan his activities after watching his TV shows accordingly. ChallengeYou are given access to Fred's laptop charging log by reading from the file "trainingdata.txt". The training data file will consist of 100 lines, each with 2 comma-separated numbers.The first number denotes the amount of time the laptop was charged The second number denotes the amount of time the battery lasted. The training data file can be downloaded here (this will be the same training data used when your program is run). The input for each of the test cases will consist of exactly 1number rounded to 2 decimal places. For each input, output 1 number  the amount of time you predict his battery will last.

**Data Analytics**
**Program Elective 5**

| MCO 126A | Text, Web and Social Media Analytic | 3-0-0 |
|---|---|---|

**Course Objectives**

1. To provide an overview of common text mining and social media data analytic activities.

2. To understand the complexities of processing text and network data from different datasources. 3. To enable students to solve complex real-world problems for sentiment analysis and Recommendation systems.

| | |
|---|---|
| **UNIT 1** | **Introduction to Text Mining**<br>Text Representation- tokenization, stemming, stop words, TF-IDF, Feature Vector Representation, NER,N-gram modeling. |
| **UNIT 2** | **Mining Textual Data**<br>Text Clustering, Text Classification, Topic Modeling-LDA,HDP |
| **UNIT 3** | **Introduction to Web-Mining** Invertedindices and Boolean queries.PLSI,Query optimization,pageranking.<br>**Web Usage Web content Mining** Essentials of Social graphs,Social Networks,Models,Information DiffusioninS ocial Media. |
| **UNIT 4** | **Introduction to Social Media Network** Mining Social Media,Behavioral Analytics, Influence and Homophily,Recommendation in Social Media<br>**Sentimental Mining** Sentiment Classification ,feature based opinion mining, comparative sentence and relational mining, Opinion spam. |
| **UNIT 5** | **Recent Threads** : Recent Trends in Text, Web and Social Media Analytics |

**Course Outcome**

1. Interpret the terminologies, metaphors and perspectives of social media analytics.
2. Apply a wide range of classification, clustering, estimation and prediction algorithms on Textual data.
3. Perform social network analysis to identify important social actors, subgroups and network properties in social media sites.
4. Apply state of the art web mining tools and libraries on realistic data sets as a basis for business decisions and applications.
5. Provide solutions to the emerging problems with social media such as behaviour analytics and Recommendation systems.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

| **Course Outcome** | **Program Outcome** | | | | | | | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | L | | | | L | | | | | L | | | L | |
| CO2 | L | L | M | | | | | | | | | | L | | |
| CO3 | | M | | | M | L | | | | | L | | | M | |
| CO4 | L | M | M | | | | | | | | | | M | | |
| CO5 | | H | | | L | | | | | | L | | | | |

**H = Highly Related; M = Medium L = Low**

## Text and Reference Books


1.BingLiu,“WebDataMining-ExploringHyperlinks,Contents,andUsageData”,Springer,Second Edition, 2011.

2.RezaZafarani,MohammadAliAbbasiandHuanLiu,“SocialMediaMining-AnIntroduction”, Cambridge University Press, 2014.

3.Bing Liu, “Sentiment Analysis and Opinion Mining”, Morgan & Claypool Publishers, 2012.

4.NitinIndurkhya,FredJDamerau,“HandbookofNaturalLanguageProcess”,2ndEdition,CRC Press, 2010.

5.Matthew A. Russell,