



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF INFORMATION TECHNOLOGY**

## **COURSE STRUCTURE AND SYLLABUS**

**For UG – R20**

**B. TECH - INFORMATION TECHNOLOGY**

*(Applicable for batches admitted from 2020-2021)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**

**KAKINADA - 533 003, Andhra Pradesh, India**


**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**
**KAKINADA – 533 003, Andhra Pradesh, India**
**DEPARTMENT OF INFORMATION TECHNOLOGY**
**COURSE STRUCTURE**

| <b>I Year – I SEMESTER</b> |                    |  |             |          |          |                |
|----------------------------|--------------------|--|-------------|----------|----------|----------------|
| <b>S. No</b>               | <b>Course Code</b> | <b>Courses</b>   | <b>L</b>    | <b>T</b> | <b>P</b> | <b>Credits</b> |
| 1                          | HS                 | Communicative English                                    | 3           | 0        | 0        | 3              |
| 2                          | BS                 | Mathematics - I<br>(Calculus And Differential Equations) | 3           | 0        | 0        | 3              |
| 3                          | BS                 | Applied Physics  | 3           | 0        | 0        | 3              |
| 4                          | ES                 | Programming for Problem Solving using C                  | 3           | 0        | 0        | 3              |
| 5                          | ES                 | Computer Engineering Workshop                            | 1           | 0        | 4        | 3              |
| 6                          | HS                 | English Communication Skills Laboratory                  | 0           | 0        | 3        | 1.5            |
| 7                          | BS                 | Applied Physics Lab                                      | 0           | 0        | 3        | 1.5            |
| 8                          | ES                 | Programming for Problem Solving using C Lab              | 0           | 0        | 3        | 1.5            |
| <b>Total Credits</b>       |                    |  | <b>19.5</b> |          |          |                |

| <b>I Year – II SEMESTER</b> |                    |  |             |          |          |                |
|-----------------------------|--------------------|--|-------------|----------|----------|----------------|
| <b>S. No</b>                | <b>Course Code</b> | <b>Courses</b>   | <b>L</b>    | <b>T</b> | <b>P</b> | <b>Credits</b> |
| 1                           | BS                 | Mathematics – II<br>(Linear Algebra And Numerical Methods) | 3           | 0        | 0        | 3              |
| 2                           | BS                 | Applied Chemistry  | 3           | 0        | 0        | 3              |
| 3                           | ES                 | Computer Organization                                      | 3           | 0        | 0        | 3              |
| 4                           | ES                 | Python Programming   | 3           | 0        | 0        | 3              |
| 5                           | ES                 | Data Structures  | 3           | 0        | 0        | 3              |
| 6                           | BS                 | Applied Chemistry Lab                                      | 0           | 0        | 3        | 1.5            |
| 7                           | ES                 | Python Programming Lab                                     | 0           | 0        | 3        | 1.5            |
| 8                           | ES                 | Data Structures Lab  | 0           | 0        | 3        | 1.5            |
| 9                           | MC                 | Environment Science  | 2           | 0        | 0        | 0              |
| <b>Total Credits</b>        |                    |  | <b>19.5</b> |          |          |                |



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| <b>II Year – I SEMESTER</b> |                    |   |             |          |          |                |
|-----------------------------|--------------------|---|-------------|----------|----------|----------------|
| <b>S.No</b>                 | <b>Course Code</b> | <b>Courses</b>  | <b>L</b>    | <b>T</b> | <b>P</b> | <b>Credits</b> |
| 1                           | BS                 | Mathematics III   | 3           | 0        | 0        | 3              |
| 2                           | IT                 | Object Oriented Programming through C++   | 3           | 0        | 0        | 3              |
| 3                           | IT                 | Operating Systems   | 3           | 0        | 0        | 3              |
| 4                           | IT                 | Database Management Systems   | 3           | 0        | 0        | 3              |
| 5                           | IT                 | Discrete Mathematics and Graph Theory   | 3           | 0        | 0        | 3              |
| 6                           | IT                 | Object Oriented Programming through C++ Lab   | 0           | 0        | 3        | 1.5            |
| 7                           | IT                 | Operating Systems Lab   | 0           | 0        | 3        | 1.5            |
| 8                           | IT                 | Database Management Systems Lab   | 0           | 0        | 3        | 1.5            |
| 9                           | SO                 | <b>Skill Oriented Course I</b><br>1) Animations- 2D Animation<br>2) Distributed Technologies- NoSQL | 0           | 0        | 4        | 2              |
| 10                          | MC                 | Constitution of India   | 2           | 0        | 0        | 0              |
| <b>Total Credits</b>        |                    |   | <b>21.5</b> |          |          |                |

| <b>II Year – II SEMESTER</b> |                    |  |             |          |          |                |
|------------------------------|--------------------|--|-------------|----------|----------|----------------|
| <b>S.No</b>                  | <b>Course Code</b> | <b>Courses</b>   | <b>L</b>    | <b>T</b> | <b>P</b> | <b>Credits</b> |
| 1                            | BS                 | Statistics with R  | 2           | 0        | 2        | 3              |
| 2                            | IT                 | Principles of Software Engineering   | 3           | 0        | 0        | 3              |
| 3                            | IT                 | Automata Theory and Compiler Design  | 3           | 0        | 0        | 3              |
| 4                            | ES                 | Java Programming   | 3           | 0        | 0        | 3              |
| 5                            | HS                 | Managerial Economics and Financial Accountancy   | 3           | 0        | 0        | 3              |
| 6                            | IT                 | UML Lab  | 0           | 1        | 2        | 2              |
| 7                            | IT                 | FOSS Lab   | 0           | 0        | 2        | 1              |
| 8                            | ES                 | Java Programming Lab   | 0           | 0        | 3        | 1.5            |
| 9                            | SO                 | <b>Skill Oriented Course II</b><br>1) Animations- 3D Animation <b>OR</b><br>2) Distributed Technologies- MongoDB | 0           | 0        | 4        | 2              |
| <b>Total Credits</b>         |                    |  | <b>21.5</b> |          |          |                |
| 10                           | Minor              | Object Oriented Programming through C++ <sup>\$</sup>  | 3           | 0        | 2        | 3+1            |
| 11                           | Honors             | Any course from the Pool, as per the opted track   | 4           | 0        | 0        | 4              |

<sup>\$</sup>- Integrated Course



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| <b>III B. Tech – I Semester</b> |                            |  |                       |          |          |                |
|---------------------------------|----------------------------|--|-----------------------|----------|----------|----------------|
| <b>S.No</b>                     | <b>Course Code</b>         | <b>Courses</b>   | <b>Hours per week</b> |          |          | <b>Credits</b> |
|                                 |                            |  | <b>L</b>              | <b>T</b> | <b>P</b> | <b>C</b>       |
| 1                               | PC                         | Computer Networks  | 3                     | 0        | 0        | 3              |
| 2                               | PC                         | Design and Analysis of Algorithms  | 3                     | 0        | 0        | 3              |
| 3                               | PC                         | Data Mining Techniques   | 3                     | 0        | 0        | 3              |
| 4                               | Open Elective/Job Oriented | <b>Open Elective-I</b><br>Open Electives offered by other departments/<br>DevOps (Job Oriented course)   | 3                     | 0        | 0        | 3              |
| 5                               | PE                         | <b>Professional Elective-I</b><br>1. Artificial Intelligence<br>2. Agile Software Process<br>3. Distributed Systems<br>4. Advanced Unix Programming    | 3                     | 0        | 0        | 3              |
| 6                               | PC                         | Data Mining Techniques with R Lab  | 0                     | 0        | 3        | 1.5            |
| 7                               | PC                         | Computer Networks Lab  | 0                     | 0        | 3        | 1.5            |
| 8                               | SO                         | <b>Skill Oriented Course - III</b><br>1.Animation course: Animation Design <b>OR</b><br>2. Continuous Integration and Continuous Delivery using DevOps | 0                     | 0        | 4        | 2              |
| 9                               | MC                         | Employability Skills-I   | 2                     | 0        | 0        | 0              |
| 10                              | PR                         | <b>Summer Internship 2 Months(Mandatory) after second year(to be evaluated during V semester</b>   | 0                     | 0        | 0        | 1.5            |
| <b>Total credits</b>            |                            |  |                       |          |          | <b>21.5</b>    |
| 11                              | Minor                      | Computer Networks <sup>\$</sup>  | 3                     | 0        | 2        | 3+1            |
| 12                              | Honors                     | Any course from the Pool, as per the opted track   | 4                     | 0        | 0        | 4              |

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| <b>III B. Tech – II Semester</b>   |                                |  |                       |          |          |                |
|--|--------------------------------|--|-----------------------|----------|----------|----------------|
| <b>S.No</b>  | <b>Course Code</b>             | <b>Courses</b>   | <b>Hours per week</b> |          |          | <b>Credits</b> |
|  |                                |  | <b>L</b>              | <b>T</b> | <b>P</b> | <b>C</b>       |
| 1  | PC                             | Machine Learning   | 3                     | 0        | 0        | 3              |
| 2  | PC                             | Big Data Analytics   | 3                     | 0        | 0        | 3              |
| 3  | PC                             | Cryptography and Network Security  | 3                     | 0        | 0        | 3              |
| 4  | PE                             | <b>Professional Elective-II</b><br>1.Mobile Computing<br>2.MEAN Stack Development<br>3. Design Patterns<br>4.Scripting Languages | 3                     | 0        | 0        | 3              |
| 5  | Open Elective/<br>Job Oriented | <b>Open Elective-II</b><br>Open Electives offered by other departments   | 3                     | 0        | 0        | 3              |
| 6  | PC                             | Big Data Analytics lab   | 0                     | 0        | 3        | 1.5            |
| 7  | PC                             | Machine Learning using Python Lab  | 0                     | 0        | 3        | 1.5            |
| 8  | PC                             | Cryptography and Network Security Lab  | 0                     | 0        | 3        | 1.5            |
| 9  | SO                             | <b>Skill Oriented Course - IV</b><br>1.Data Science: Natural Language Processing <b>OR</b><br>2.Video Analytics                  | 0                     | 0        | 4        | 2              |
| 10   | MC3201                         | Employability skills-II  | 2                     | 0        | 0        | 0              |
| <b>Total credits</b>   |                                |  |                       |          |          | <b>21.5</b>    |
| <b>Industrial/Research Internship(Mandatory) 2 Months during summer vacation</b> |                                |  |                       |          |          |                |
| 11   | Minor                          | Data Structures and Algorithms <sup>\$</sup>   | 3                     | 0        | 2        | 3+1            |
| 12   | Honors                         | Any course from the Pool, as per the opted track   | 4                     | 0        | 0        | 4              |
| <b>Minor course through SWAYAM</b>   |                                |  | -                     | -        | -        | <b>2</b>       |

\$- Integrated Course



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| <b>IV B. Tech –I Semester</b>      |                             |   |                       |          |          |                |
|------------------------------------|-----------------------------|---|-----------------------|----------|----------|----------------|
| <b>S.No</b>                        | <b>Course Code</b>          | <b>Course Title</b>   | <b>Hours per week</b> |          |          | <b>Credits</b> |
|                                    |                             |   | <b>L</b>              | <b>T</b> | <b>P</b> | <b>C</b>       |
| 1                                  | PE                          | <b>Professional Elective-III</b><br>1.Cloud Computing<br>2. Artificial Neural Networks<br>3. Internet of Things (IoT)<br>4.Cyber Security & Forensics | 3                     | 0        | 0        | 3              |
| 2                                  | PE                          | <b>Professional Elective-IV</b><br>1. Deep Learning Techniques<br>2. Social Networks Analysis<br>3. Advanced Databases<br>4.MOOCs-NPTEL/SWAYAM        | 3                     | 0        | 0        | 3              |
| 3                                  | PE                          | <b>Professional Elective-V</b><br>1.Block-Chain Technologies<br>2.M-Commerce<br>3.Ethical Hacking<br>4.MOOCs-NPTEL/SWAYAM                             | 3                     | 0        | 0        | 3              |
| 4                                  | Open Elective /Job Oriented | <b>Open Elective-III</b><br>Open Electives offered by other departments   | 2                     | 0        | 2        | 3              |
| 5                                  | Open Elective /Job Oriented | <b>Open Elective-IV</b><br>Open Electives offered by other departments  | 2                     | 0        | 2        | 3              |
| 6                                  | HS                          | Universal Human Values 2: Understanding Harmony   | 3                     | 0        | 0        | 3              |
| 7                                  | SO                          | PYTHON: Deep Learning <b>OR</b><br>Secure Coding Techniques <b>OR</b><br>APSSDC offered Courses   | 0                     | 0        | 4        | 2              |
| 8                                  | PR                          | <b>Industrial/Research Internship 2 months (Mandatory) after third year (to be evaluated during VII semester)</b>                                     | 0                     | 0        | 0        | 3              |
| <b>Total credits</b>               |                             |   |                       |          |          | <b>23</b>      |
| 11                                 | Minor                       | Software Engineering <sup>\$</sup> / any other from PART-B (For Minor)  | 3                     | 0        | 2        | 3+1            |
| 12                                 | Honors                      | Any course from the Pool, as per the opted track  | 4                     | 0        | 0        | 4              |
| <b>Minor course through SWAYAM</b> |                             |   | -                     | -        | -        | <b>2</b>       |

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| <b>IV B. Tech –II Semester</b> |                    |  |                       |          |          |                |
|--------------------------------|--------------------|--|-----------------------|----------|----------|----------------|
| <b>S.No</b>                    | <b>Course Code</b> | <b>Course Title</b>                    | <b>Hours per week</b> |          |          | <b>Credits</b> |
|                                |                    |  | <b>L</b>              | <b>T</b> | <b>P</b> | <b>C</b>       |
| 1                              | Project            | Major Project Work, Seminar Internship | -                     | -        | -        | <b>12</b>      |
| <b>Total credits</b>           |                    |  |                       |          |          | <b>12</b>      |

Note:

1. **For integrated courses:** Theory and laboratory exams will be conducted separately, and the student concern will get credits if successfully completes both theory and laboratory. Only external exam will be conducted for Laboratory component. Credit based weightage shall be considered while awarding the grade.
2. **For MOOC courses:** Based on the students interest, student can register and complete a 12 week course one year in advance, by prior information to the concern.



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**SUGGESTED COURSES FOR HONORS PROGRAM**

|   |  |
|---|--|
| <b>POOL1- AI &amp; ML</b> <ol style="list-style-type: none"> <li>1. Mathematics for Machine Learning</li> <li>2. Text Mining and Time Series Analysis</li> <li>3. Natural Language Processing</li> <li>4. Reinforcement Learning</li> </ol>   | <b>POOL2- Systems Engineering</b> <ol style="list-style-type: none"> <li>1. Internet of Things</li> <li>2. Data Communications and Information Coding Theory</li> <li>3. Service Oriented Architectures</li> <li>4. Design of Secure Protocols</li> <li>5. Network Coding</li> </ol> |
| <b>POOL3- Information Security</b> <ol style="list-style-type: none"> <li>1. Principles of Cyber Security</li> <li>2. Computational Number Theory</li> <li>3. Cryptanalysis</li> <li>4. Elliptic Curve Cryptography</li> <li>5. Introduction to Quantum Computing and Quantum Cryptography</li> <li>6. Public Key Infrastructure and Trust Management</li> <li>7. Information Security Analysis and Audit</li> <li>8. Cloud and IoT Security</li> <li>9. Web Security</li> <li>10. Block Chain Architecture Design and Use Cases</li> </ol> | <b>POOL4 – Data Science</b> <ol style="list-style-type: none"> <li>1. Data Visualization</li> <li>2. Statistical Foundations for Data Science</li> <li>3. Mining Massive Data Sets</li> <li>4. Medical Image Data Processing</li> </ol>  |



## DEPARTMENT OF INFORMATION TECHNOLOGY

**Note:**

- ### Eligibility for Minor in IT:

| PART A       |                                |       |         |  |   |   |
|--------------|--------------------------------|-------|---------|--|---|---|
| Regular Mode |                                |       |         | MOOCS*                                   |   |   |
| S.No         | Subject                        | L-T-P | Credits | Course available in NPTEL                | NPTEL Link  | Credits   |
| 1            | Operating Systems              | 3-0-2 | 4       | Operating Systems                        | <a href="https://onlinecourses.swayam2.ac.in/cec21_cs20/preview">https://onlinecourses.swayam2.ac.in/cec21_cs20/preview</a> | As recommended by the NPTEL (Dept need to verify the credits and suggest) |
| 2            | Data Structures and Algorithms | 3-0-2 | 4       | Data Structure and algorithms using Java | <a href="https://nptel.ac.in/courses/106105225">https://nptel.ac.in/courses/106105225</a>                                   |   |
| 3            | Software Engineering           | 3-0-2 | 4       | Software Engineering                     | <a href="https://onlinecourses.swayam2.ac.in/cec21_cs21/preview">https://onlinecourses.swayam2.ac.in/cec21_cs21/preview</a> |   |
| 4            | Computer Networks              | 3-0-2 | 4       | Computer Networks                        | <a href="https://onlinecourses.swayam2.ac.in/cec22_cs05/preview">https://onlinecourses.swayam2.ac.in/cec22_cs05/preview</a> |   |
| 5            | Database Management Systems    | 3-0-2 | 4       | Data Base Management System              | <a href="https://onlinecourses.nptel.ac.in/noc22_cs51/preview">https://onlinecourses.nptel.ac.in/noc22_cs51/preview</a>     |   |

\* If sufficient number of students are not available to offer, can pursue under MOOCS

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| PART B |   |       |         |   |   |   |
|--------|---|-------|---------|---|---|---|
| S.No   | Subject                                 | L-T-P | Credits | Course available in NPTEL                                       | NPTEL Link  | Credits   |
| 1      | Object Oriented Programming through C++ | 3-0-2 | 4       | Programming in C++ (Two Credits)                                | <a href="https://onlinecourses.nptel.ac.in/noc21_cs02/preview">https://onlinecourses.nptel.ac.in/noc21_cs02/preview</a> | As recommended by the NPTEL (Dept need to verify the credits and suggest) |
| 2      | Data Analytics using Python             | 3-0-2 | 4       | Data Analytics with Python                                      | <a href="https://nptel.ac.in/courses/106107220">https://nptel.ac.in/courses/106107220</a>                               |   |
| 3      | Artificial Intelligence                 | 4-0-0 | 4       | Artificial Intelligence: Knowledge Representation And Reasoning | <a href="https://nptel.ac.in/courses/106106140">https://nptel.ac.in/courses/106106140</a>                               |   |
|        |   |       |         | OR  |   |   |
|        |   |       |         | An Introduction to Artificial Intelligence                      | <a href="https://onlinecourses.nptel.ac.in/noc22_cs56/preview">https://onlinecourses.nptel.ac.in/noc22_cs56/preview</a> |   |
| 4      | Unix and Shell Programming              | 3-0-2 | 4       |   |   |   |
| 5      | Cloud Computing                         | 4-0-0 | 4       | Cloud computing   | <a href="https://onlinecourses.nptel.ac.in/noc22_cs20/preview">https://onlinecourses.nptel.ac.in/noc22_cs20/preview</a> |   |
|        |   |       |         | OR  |   |   |
|        |   |       |         | Cloud Computing and Distributed Systems (TWO Credits)           | <a href="https://onlinecourses.nptel.ac.in/noc21_cs15/preview">https://onlinecourses.nptel.ac.in/noc21_cs15/preview</a> |   |

\* If sufficient number of students are not available to offer, can pursue under MOOCS



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| III Year – II Semester  |   |   |   |   |
|-------------------------|---|---|---|---|
|                         | L | T | P | C |
|                         | 3 | 0 | 0 | 3 |
| <b>MACHINE LEARNING</b> |   |   |   |   |

**Course Objectives:**

- Identify problems that are amenable to solution by ANN methods, and which ML methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different ANN methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).

**Course Outcomes:** After the completion of the course, student will be able to

- Explain the fundamental usage of the concept Machine Learning system
- Demonstrate on various regression Technique
- Analyze the Ensemble Learning Methods
- Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning.
- Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

**Unit I:**

**Introduction-** Artificial Intelligence, Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning.

**Statistical Learning:** Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator, Empirical Risk Minimization.

**Unit II:**

**Supervised Learning**(Regression/Classification):Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, **Linear Models:** Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, **Binary Classification:** Multiclass/Structured outputs, MNIST, Ranking.

**Unit III:**

**Ensemble Learning and Random Forests:** Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.

**Support Vector Machine:** Linear SVM Classification, Nonlinear SVM Classification SVM Regression, Naïve Bayes Classifiers.

**Unit IV:**

**Unsupervised Learning Techniques:** Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures.

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.

**Unit V:**

**Neural Networks and Deep Learning:** Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.



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**Text Books:**

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
2. Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 25th November 2020

**Reference Books:**

1. Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.



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|---------------------------|---|---|---|---|
|                           | L | T | P | C |
|                           | 3 | 0 | 0 | 3 |
| <b>BIG DATA ANALYTICS</b> |   |   |   |   |

**Course Objectives:**

- To optimize business decisions and create competitive advantage with Big Data analytics
- To learn to analyze the big data using intelligent techniques
- To introduce programming tools PIG & HIVE in Hadoop ecosystem

**Course Outcomes:**

At the end of the course, the students will be able to

- Illustrate big data challenges in different domains including social media, transportation, finance and medicine
- Use various techniques for mining data stream
- Design and develop Hadoop
- Identify the characteristics of datasets and compare the trivial data and big data for various applications
- Explore the various search methods and visualization techniques

**UNIT I:**

Introduction: Introduction to big data: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

**UNIT II:**

Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies - Real Time Sentiment Analysis - Stock Market Predictions.

**UNIT III:**

Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

**UNIT IV:**

Frameworks and Applications: Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and ZooKeeper.

**UNIT V:**

Predictive Analytics and Visualizations: Predictive Analytics, Simple linear regression, Multiple linear regression, Interpretation of regression coefficients, Visualizations, Visual data analysis techniques, interaction techniques, Systems and application



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**Text Books:**

1. Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’reilly Media, Fourth Edition, 2015.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.
3. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012

**Reference Books:**

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
2. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, “Harness the Power of Big Data: The IBM Big Data Platform”, Tata McGraw Hill Publications, 2012.
3. Arshdeep Bahga and Vijay Madisetti, “Big Data Science & Analytics: A Hands On Approach”, VPT, 2016.
4. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons, 2014.

**Software Links:**

1. Hadoop: <http://hadoop.apache.org/>
2. Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
3. Piglatin: <http://pig.apache.org/docs/r0.7.0/tutorial.html>


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**DEPARTMENT OF INFORMATION TECHNOLOGY**

| III Year – II Semester                   |   |   |   |   |
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| <b>CRYPTOGRAPHY AND NETWORK SECURITY</b> |   |   |   |   |

**Course Objectives:**

The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and SSL/TLS.

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

- Explain different security threats and countermeasures and foundation course of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography
- Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more
- Design applications of hash algorithms, digital signatures and key management techniques
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL,TSL, and IPsec .

**UNIT I:**

**Basic Principles :** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.

**UNIT II:**

**Symmetric Encryption:** Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

**UNIT III:**

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

**UNIT IV:**

**Data Integrity, Digital Signature Schemes & Key Management :** Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

**UNIT V:**

**Network Security-I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II :** Security at the Network Layer: IPSec, System Security

**Text Books:**

1. Cryptography and Network Security, 3<sup>rd</sup> Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill,2015
2. Cryptography and Network Security,4<sup>th</sup> Edition, William Stallings, (6e) Pearson,2006
3. Everyday Cryptography, 1<sup>st</sup> Edition, Keith M.Martin, Oxford,2016

**Reference Books:**

1. Network Security and Cryptography, 1<sup>st</sup> Edition, Bernard Meneges, Cengage Learning,2018





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| MOBILE COMPUTING<br>(Professional Elective-II) |  |   |   |   |   |

**Course Objectives:**

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents

**Course Outcomes:** Upon completion of the course, the students will be able to:

- Develop a strong grounding in the fundamentals of mobile Networks
- Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Comprehend, design, and develop a lightweight network stack
- Analyze the Mobile Network Layer system working
- Explain about the WAP Model

**UNIT I:**

**Introduction to Wireless Networks:** Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.

**UNIT II:**

**MAC –** Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

**UNIT III:**

**Wireless LAN:** Infrared vs. Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11 WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

**UNIT IV:**

**Mobile Network Layer:** Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

**UNIT V:**

**Support for Mobility:** Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

**Text Books:**

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Education, 2008.

**Reference Books:**

1. William Stallings, “Wireless Communications and Networks”, Second Edition, Pearson Education, 2004.
2. C. Siva Ram Murthy, B. S. Manoj, “Adhoc Wireless Networks: Architectures and Protocols”, Second Edition, Pearson Education, 2008.





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| <b>MEAN STACK DEVELOPMENT</b><br><b>(Professional Elective II)</b> |   |   |   |   |

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Build static web pages using HTML 5 elements.
- Apply JavaScript to embed programming interface for web pages and also to perform Client side validations.
- Build a basic web server using Node.js, work with Node Package Manager (NPM) and recognize the need for Express.js.
- Develop JavaScript applications using typescript and work with document database using MongoDB.
- Utilize Angular JS to design dynamic and responsive web pages.

**UNIT-I:**

**HTML 5:** Introduction to Web, Overview of Web Technologies, HTML - Introduction, HTML - Need, Case-insensitivity, Platform-independency, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element, Sectioning Elements, Paragraph Element, Division and Span Elements, List Element, Link Element, Character Entities, HTML5 Global Attributes, Creating Table Elements, Table Elements : Colspan/ Rowspan Attributes, border, cellpadding and cellspacing attributes, Creating Form Elements, Input Elements - Attributes, Color and Date Pickers, Select and Datalist Elements, Editing Elements, Media, Iframe, Why HTML Security, HTML Injection, Clickjacking, HTML5 Attributes & Events Vulnerabilities, Local Storage Vulnerabilities, HTML5 - Cross-browser support, Best Practices For HTML Web Pages.

**UNIT-II:**

**JavaScript:** Why we need JavaScript, What is JavaScript, Environment Setup, Working with Identifiers, Type of Identifiers, Primitive and Non Primitive Data Types, Operators and Types of Operators, Types of Statements, Non - Conditional Statements, Types of Conditional Statements, If and Switch Statements, Types of Loops, Types of Functions, Declaring and Invoking Function, Arrow Function, Function Parameters, Nested Function, Built-in Functions, Variable Scope in Functions, Working With Classes, Creating and Inheriting Classes, In-built Events and Handlers, Working with Objects, Types of Objects, Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser and Document Object Model, Creating Arrays, Destructuring Arrays, Accessing Arrays, Array Methods, Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API, Creating and consuming Modules.

**UNIT-III:**

**Node.js:** Why and What Node.js, How to use Node.js, Create a web server in Node.js, Node Package Manager, Modular programming in Node.js, Restarting Node Application, File Operations.

**Express.js:** Express Development Environment, Defining a route, Handling Routes, Route and Query Parameters, How Middleware works, Chaining of Middlewares, Types of Middlewares, Connecting to MongoDB with Mongoose, Validation Types and Defaults, Models, CRUD Operations, API Development, Why Session management, Cookies, Sessions, Why and What Security, Helmet Middleware, Using a Template Engine Middleware, Stylus CSS Preprocessor.



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#### UNIT-IV:

**Typescript:** Installing TypeScript, Basics of TypeScript, Function, Parameter Types and Return Types, Arrow Function, Function Types, Optional and Default Parameters, Rest Parameter, Creating an Interface, Duck Typing, Function Types, Extending Interfaces, Classes, Constructor, Access Modifiers, Properties and Methods, Creating and using Namespaces, Creating and using Modules, Module Formats and Loaders, Module Vs Namespace, What is Generics, What are Type Parameters, Generic Functions, Generic Constraints.

**MongoDB:** Introduction Module Overview, Document Database Overview, Understanding JSON, MongoDB Structure and Architecture, MongoDB Remote Management, Installing MongoDB on the local computer (Mac or Windows), Introduction to MongoDB Cloud, Create MongoDB Atlas Cluster, GUI tools Overview, Install and Configure MongoDB Compass, Introduction to the MongoDB Shell, MongoDB Shell JavaScript Engine, MongoDB Shell JavaScript Syntax, Introduction to the MongoDB Data Types, Introduction to the CRUD Operations on documents, Create and Delete Databases and Collections, Introduction to MongoDB Queries.

#### UNIT-V:

What is Angular, Features of Angular, Angular Application Setup, Components and Modules, Executing Angular Application, Elements of Template, Change Detection, Structural Directives - ngIf, ngFor, ngSwitch, Custom Structural Directive, Attribute Directives - ngStyle, ngClass, Custom Attribute Directive, Property Binding, Attribute Binding, Style and Event Binding, Built in Pipes, Passing Parameters to Pipes, Nested Components Basics, Passing data from Container Component to Child Component, Passing data from Child Component to ContainerComponent, Shadow DOM, Component Life Cycle, Template Driven Forms, Model Driven Forms or Reactive Forms, Custom Validators in Reactive Forms, Custom Validators in Template Driven forms, Dependency Injection, Services Basics, RxJS Observables, Server Communication using HttpClient, Communicating with different backend services using Angular HttpClient, Routing Basics, Router Links, Route Guards, Asynchronous Routing, Nested Routes.

#### Text Books:

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1<sup>st</sup> edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly.

#### Reference Books:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda SKatila, Cengage Learning.

#### Web Links:

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_17739732834840810000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview) (HTML5)
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_18109698366332810000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview) (Javascript)
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_32407835671946760000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview) (Node.js & Express.js)



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4. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_9436233116512678000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview)  
(Typescript)
5. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_20858515543254600000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview)  
(Angular JS)
6. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview)  
w (MongoDB)



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| <b>DESIGN PATTERNS</b><br><b>(Professional Elective II)</b> |   |   |   |   |

**Course Objectives:**

- Demonstration of patterns related to object oriented design.
- Describe the design patterns that are common in software applications
- Analyze a software development problem and express it
- Design a module structure to solve a problem, and evaluate alternatives
- Implement a module so that it executes efficiently and correctly

**Course Outcomes:**

- Construct a design consisting of a collection of modules
- Examine well-known design patterns (such as Iterator, Observer, Factory and Visitor)
- Distinguish between different categories of design patterns
- Ability to understand and apply common design patterns to incremental /iterative development
- Identify appropriate patterns for design of given problem
- Design the software using Pattern Oriented Architectures

**UNIT I:**

Introduction: Design Pattern, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.

**UNIT II:**

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

**UNIT III:**

Structural Pattern: Adapter, Bridge, Composite, Decorator, façade, Flyweight, Proxy.

**UNIT IV:**

Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer.

**UNIT V:**

Behavioral Patterns: State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns.

What to Expect from Design Patterns, a Brief History, the Pattern Community an Invitation, a Parting Thought.

**Text Books:**

1. “Design Patterns”, Erich Gamma, Pearson Education.



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**Reference Books:**

1. “Head First Design patterns”, Eric Freeman & Elisabeth Freeman, O'REILLY, 2007.
2. “Design Patterns in Java”, Steven John Metsker & William C. Wake, Pearson education, 2006
3. “J2EE Patterns”, Deepak Alur, John Crupi & Dan Malks, Pearson education, 2003.
4. “Design Patterns in C#”, Steven John metsker, Pearson education, 2004.
5. “Pattern Oriented Software Architecture”, F.Buschmann & others, John Wiley & Sons.

**e-Resources:**

1. <https://www.javatpoint.com/design-patterns-in-java>
2. [https://www.tutorialspoint.com/design\\_pattern/design\\_pattern\\_overview.htm](https://www.tutorialspoint.com/design_pattern/design_pattern_overview.htm)



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| <b>SCRIPTING LANGUAGES</b><br><b>(Professional Elective II)</b> |   |   |   |   |

**Course Objectives:**

From the course the student will

- Understand the concepts of scripting languages for developing web based projects
- Illustrates object oriented concepts like PHP, PYTHON, PERL
- Create database connections using PHP and build the website for the world
- Demonstrate IP address for connecting the web servers
- Analyze the internet ware application, security issues and frame works for application

**Course Outcomes:**

After the completion of the course, student will be able to do the following

- Ability to understand the differences between scripting languages
- Create PHP authentication Methodology for security issues
- Identify PHP encryption functions and Mcrypt Package
- Explain syntax and variables in TCL
- Able to gain some fluency programming in Ruby, JavaScript, Perl, Python, and related languages
- Master an understanding of python especially the object oriented concepts

**UNIT I:**

Introduction to PERL and Scripting: Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages, Uses for Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

**UNIT II:**

Advanced PERL: Finer points of looping, pack and unpack, file system, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

PHP Basics: PHP Basics- Features, Embedding PHP Code in your Web pages, Outputting the data to the browser, Data types, Variables, Constants, expressions, string interpolation, control structures, Function, Creating a Function, Function Libraries, Arrays, strings and Regular Expressions.

**UNIT III:**

Advanced PHP Programming: PHP and Web Forms, Files, PHP Authentication and Methodologies- Hard Coded, File Based, Database Based, IP Based, Login Administration, Uploading Files with PHP, Sending Email using PHP, PHP Encryption Functions, the Mcrypt package, Building Web sites for the World.

**UNIT IV:**

TCL: TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures , strings , patterns, files, Advance TCL- eval, source, exec and uplevel commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface. Tk-Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding , Perl-Tk.



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**UNIT V:**

Python: Introduction to Python language, python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling. Integrated Web Applications in Python – Building Small, Efficient Python Web Systems, Web Application Framework.

**Text Books:**

1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Python Web Programming, Steve Holden and David Beazley, New Riders Publications.
3. Beginning PHP and MySQL, 3<sup>rd</sup> Edition, Jason Gilmore, Apress Publications (Dream tech).

**References Books:**

1. Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP, J.Lee and B.Ware (Addison Wesley) Pearson Education. Programming Python, M.Lutz, SPD.
2. PHP 6 Fast and Easy Web Development, Julie Meloni and Matt Telles, Cengage Learning Publications.
3. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
4. PHP and MySQL by Example, E.Quigley, Prentice Hall (Pearson).
5. Perl Power, J.P.Flynt, Cengage Learning.





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| <b>BIG DATA ANALYTICS LAB</b> |   |   |   |     |

**Software Requirements :**

1. **Hadoop** : <https://hadoop.apache.org/release/2.7.6.html>
2. **Java** : <https://www.oracle.com/java/technologies/javase/javase8u211-later-archive-downloads.html>
3. **Eclipse** : <https://www.eclipse.org/downloads/>

**List of Experiments:**

**Experiment 1: Week 1, 2:**

1. Implement the following Data structures in Java
  - a) Linked Lists
  - b) Stacks
  - c) Queues
  - d) Set
  - e) Map

**Experiment 2: Week 3:**

2. (i) Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed  
 (ii) Use web based tools to monitor your Hadoop setup.

**Experiment 3: Week 4:**

3. Implement the following file management tasks in Hadoop:
  - Adding files and directories
  - Retrieving files
  - Deleting files

**Hint:** A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

**Experiment 4: Week 5:**

4. Run a basic Word Count MapReduce program to understand MapReduce Paradigm.

**Experiment 5: Week 6:**

5. Write a map reduce program that mines weather data.  
 Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

**Experiment 6: Week 7:**

6. Use MapReduce to find the shortest path between two people in a social graph.  
**Hint:** Use an adjacency list to model a graph, and for each node store the distance from the original node, as well as a back pointer to the original node. Use the mappers to propagate the distance to the original node, and the reducer to restore the state of the graph. Iterate until the target node has been reached.

**Experiment 7: Week 8:**

7. Implement Friends-of-friends algorithm in MapReduce.  
**Hint:** Two MapReduce jobs are required to calculate the FoFs for each user in a social network. The first job calculates the common friends for each user, and the second job sorts the common friends by the number of connections to your friends.





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**Experiment 8: Week 9:**

8. Implement an iterative PageRank graph algorithm in MapReduce.

**Hint:** PageRank can be implemented by iterating a MapReduce job until the graph has converged. The mappers are responsible for propagating node PageRank values to their adjacent nodes, and the reducers are responsible for calculating new PageRank values for each node, and for re-creating the original graph with the updated PageRank values.

**Experiment 9: Week 10:**

9. Perform an efficient semi-join in MapReduce.

**Hint:** Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual MapReduce data source by performing membership queries against the Bloom filter to determine which data source records should be emitted to the reducers.

**Experiment 10: Week 11:**

10. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

**Experiment 12: Week 12:**

11. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes



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| MACHINE LEARNING USING PYTHON LAB |   |   |   |     |

### Course Objectives:

This course will enable students to learn and understand different Data sets in implementing the machine learning algorithms.

**Course Outcomes (Cos):** At the end of the course, student will be able to

- Implement procedures for the machine learning algorithms
- Design and Develop Python programs for various Learning algorithms
- Apply appropriate data sets to the Machine Learning algorithms
- Develop Machine Learning algorithms to solve real world problems

**Requirements:** Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

### Experiment-1:

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

### Experiment-2:

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

### Experiment-3:

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

### Experiment-4:

Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier

**Experiment-5:** Develop a program for Bias, Variance, Remove duplicates, Cross Validation

**Experiment-6:** Write a program to implement Categorical Encoding, One-hot Encoding

### Experiment-7:

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

### Experiment-8:

Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

**Experiment-9:** Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

### Experiment-10:

Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and



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recall for your data set.

**Experiment-11:** Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

**Experiment-12:** Exploratory Data Analysis for Classification using Pandas or Matplotlib.

**Experiment-13:**

Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

**Experiment-14:**

Write a program to Implement Support Vector Machines and Principle Component Analysis

**Experiment-15:**

Write a program to Implement Principle Component Analysis



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| <b>CRYPTOGRAPHY AND NETWORK SECURITY LAB</b> |   |   |   |     |

**Course Objectives:**

- To learn basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- To understand and implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher.

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

- Apply the knowledge of symmetric cryptography to implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher
- Demonstrate the different algorithms like DES, BlowFish, and Rijndael, encrypt the text “Hello world” using Blowfish Algorithm.
- Analyze and implement public key algorithms like RSA, Diffie-Hellman Key Exchange mechanism, the message digest of a text using the SHA-1 algorithm

**List of Experiments:**

1. Write a C program that contains a string (char pointer) with a value \Hello World'. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result
3. Write a Java program to perform encryption and decryption using the following algorithms:
  - a) Ceaser Cipher
  - b) Substitution Cipher
  - c) Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the BlowFish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Using Java Cryptography, encrypt the text “Hello world” using BlowFish. Create your own key using Java key tool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.



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**DEPARTMENT OF INFORMATION TECHNOLOGY**

| III Year – II Semester   |  | L | T | P | C |
|--|--|---|---|---|---|
|  |  | 0 | 0 | 4 | 2 |
| DATA SCIENCE: NATURAL LANGUAGE PROCESSING<br>(Skill Oriented Course) |  |   |   |   |   |

**Course Outcomes:**

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

- Explore natural language processing (NLP) libraries in Python
- Learn various techniques for implementing NLP including parsing & text processing
- Understand how to use NLP for text feature engineering

**Python Libraries:** nltk, re, word2vec

**List of Experiments :**

1. Demonstrate Noise Removal for any textual data and remove regular expression pattern such as hash tag from textual data.
2. Perform lemmatization and stemming using python library nltk.
3. Demonstrate object standardization such as replace social media slangs from a text.
4. Perform part of speech tagging on any textual data.
5. Implement topic modeling using Latent Dirichlet Allocation (LDA ) in python.
6. Demonstrate Term Frequency – Inverse Document Frequency (TF – IDF) using python
7. Demonstrate word embeddings using word2vec.
8. Implement Text classification using naïve bayes classifier and text blob library.
9. Apply support vector machine for text classification.
10. Convert text to vectors (using term frequency) and apply cosine similarity to provide closeness among two text.
11. Case study 1: Identify the sentiment of tweets  
 In this problem, you are provided with tweet data to predict sentiment on electronic products of netizens.
12. Case study 2: Detect hate speech in tweets.  
 The objective of this task is to detect hate speech in tweets. For the sake of simplicity, we say a tweet contains hate speech if it has a racist or sexist sentiment associated with it. So, the task is to classify racist or sexist tweets from other tweets.

**Web References:**

1. <https://www.analyticsvidhya.com/blog/2017/01/ultimate-guide-to-understand-implement-natural-language-processing-codes-in-python/>
2. [https://datahack.analyticsvidhya.com/contest/linguipedia-codefest-natural-language-processing-1/?utm\\_source=ultimate-guide-to-understand-implement-natural-language-processing-codes-in-python&utm\\_medium=blog](https://datahack.analyticsvidhya.com/contest/linguipedia-codefest-natural-language-processing-1/?utm_source=ultimate-guide-to-understand-implement-natural-language-processing-codes-in-python&utm_medium=blog)
3. <https://www.analyticsvidhya.com/blog/2018/07/hands-on-sentiment-analysis-dataset-python/>



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**DEPARTMENT OF INFORMATION TECHNOLOGY**

| III Year – II Semester                                   |   |   |   |   |
|--|---|---|---|---|
|  | L | T | P | C |
|  | 0 | 0 | 4 | 2 |
| <b>VIDEO ANALYTICS</b><br><b>(Skill Oriented Course)</b> |   |   |   |   |

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Illustrate the principles and techniques of digital image
- Demonstrate the image recognition and motion recognition
- Discuss the fundamentals of digital video processing
- Illustrate the motion estimation, segmentation and modeling
- Analyze video processing in applications

**List of Experiments:**

Note: Implement the following applications using MATLAB/Open CV/Python

1. Image enhancement application
2. Object/image recognition applications based on digital image transforms.
3. Image analysis systems for object recognition.
4. Content Based Image Retrieval
5. Image compression, Image Fusion
6. Image Steganography, Watermarking
7. Video Enhancement and Noise Reduction
8. Motion Estimation and Segmentation,
9. Motion Tracking
10. Multi-target/Multi-camera tracking
11. Action Recognition

**List of Augmented Experiments: (Weeks 13 – Week 16)**

(Any two of the following experiments can be performed)

1. Implement Optical character recognition,
2. Implement Image Captioning and Visual Question Answering.
3. Implement Gesture Recognition.
4. Implement Smart Surveillance and Tracking

**Reference Books:**

1. "Practical Image and Video Processing Using MATLAB", Oge Marques, Wiley-IEEE Press, 2011.
2. "Image Engineering: Processing, Analysis and Understanding", Yu Jin Zhang, Tsinghua University Press, 2009.
3. "Object Detection and Recognition in Digital Images: Theory and Practice", Boguslaw Cyganek, Wiley 2013.



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| III Year – II Semester         |   |   |   |   |
|--------------------------------|---|---|---|---|
|                                | L | T | P | C |
|                                | 2 | 0 | 0 | 0 |
| <b>EMPLOYABILITY SKILLS-II</b> |   |   |   |   |

**Course Objectives:**

The main objective of this course is to assist students in developing employability skills and personal qualities related to gaining and sustaining employment.

**Course Outcomes:** After completion of this course

- Solve various Basic Mathematics problems by following different methods
- Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems
- Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
- Analyze, summarize and present information in quantitative forms including table, graphs and formulas

**UNIT I:**

**Numerical ability I:** Number system, HCF & LCM, Average, Simplification, Problems on numbers

**Numerical ability II:** Ratio & Proportion, Partnership, Percentages, Profit & Loss

**UNIT II:**

**Arithmetical ability I:** Problems on ages, Time & Work, Pipes & Cistern, Chain Rule.

**Arithmetical ability II:** Time & Distance, Problems on boats & Steams, Problems on Trains

**UNIT III:**

**Arithmetical ability III:** Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock,

**Logical ability:** Permutations and Combination and Probability.

**UNIT IV:**

**Mensuration:** Geometry, Areas, Volumes

**UNIT V:**

**Data interpretation:** Tabulation, Bar graphs, Pie charts, line graphs

**Text Books And Reference Books:**

1. R. S. Aggarwal “Quantitative Aptitude”, Revised ed., S Chand publication, 2017 ISBN:8121924987

**E- resources:**

1. [https://blog.feedspot.com/aptitude\\_youtube\\_channels/](https://blog.feedspot.com/aptitude_youtube_channels/)
2. [https://www.tutorialspoint.com/quantitative\\_apptitude/](https://www.tutorialspoint.com/quantitative_apptitude/)
3. <https://www.careerbless.com/aptitude/qa/home.php>





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| III Year – II Semester         | Minor Course | L | T | P | C |
|--------------------------------|--------------|---|---|---|---|
|                                |              | 3 | 0 | 2 | 4 |
| DATA STRUCTURES AND ALGORITHMS |              |   |   |   |   |

**Course Objectives:**

The objective of the course is to

- Introduce the fundamental concept of data structures and abstract data types
- Emphasize the importance of data structures in developing and implementing efficient algorithms
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
- Demonstrate the different data structures implementation

**Course Outcomes:**

After completing this course a student will be able to:

- Use basic data structures such as arrays and linked list.
- Programs to demonstrate fundamental algorithmic problems including Tree Traversals, Graph traversals, and shortest paths.
- Use various searching and sorting algorithms.

**UNIT I:**

Data Structures - Definition, Classification of Data Structures, Operations on Data Structures, Abstract Data Type (ADT), Preliminaries of algorithms. Time and Space complexity.

Searching - Linear search, Binary search, Fibonacci search.

Sorting- Insertion sort, Selection sort, Exchange (Bubble sort, quick sort), distribution (radix sort), merging (Merge sort) algorithms.

**UNIT II:**

Linked List: Introduction, Single linked list, Representation of Linked list in memory, Operations on Single Linked list-Insertion, Deletion, Search and Traversal, Reversing Single Linked list, Applications on Single Linked list- Polynomial Expression Representation, Addition and Multiplication, Sparse Matrix Representation using Linked List, Advantages and Disadvantages of Single Linked list, Double Linked list-Insertion, Deletion, Circular Linked list-Insertion, Deletion.

**UNIT III:**

Queues: Introduction to Queues, Representation of Queues-using Arrays and using Linked list, Implementation of Queues-using Arrays and using Linked list, Application of Queues- Circular Queues, Deques, Priority Queues, Multiple Queues.

Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on Stacks, Linked list Representation of Stacks, Operations on Linked Stack, Applications-Reversing list, Factorial Calculation, Infix to Postfix Conversion, Evaluating Postfix Expressions.

**UNIT IV:**

Trees: Basic Terminology in Trees, Binary Trees-Properties, Representation of Binary Trees using Arrays and Linked lists. Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion, Tree Traversals,





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## DEPARTMENT OF INFORMATION TECHNOLOGY

### UNIT V:

Graphs: Basic Concepts, Representations of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree Using Prim's & Kruskal's Algorithm, Dijkstra's shortest path

#### Exercise -1 (Searching)

- Write C program that use both recursive and non recursive functions to perform Linear search for a Key value in a given list.
- Write C program that use both recursive and non recursive functions to perform Binary search for a Key value in a given list.

#### Exercise -2 (Sorting-I)

- Write C program that implement Bubble sort, to sort a given list of integers in ascending order
- Write C program that implement Quick sort, to sort a given list of integers in ascending order
- Write C program that implement Insertion sort, to sort a given list of integers in ascending order

#### Exercise -3 (Sorting-II)

- Write C program that implement radix sort, to sort a given list of integers in ascending order
- Write C program that implement merge sort, to sort a given list of integers in ascending order

#### Exercise -4 (Singly Linked List)

- Write a C program that uses functions to create a singly linked list
- Write a C program that uses functions to perform insertion, deletion operations on a singly linked list
- Write a C program to reverse elements of a single linked list.

#### Exercise -5 (Queue)

- Write C program that implement Queue (its operations) using arrays.
- Write C program that implement Queue (its operations) using linked lists

#### Exercise -6 (Stack)

- Write C program that implement stack (its operations) using arrays
- Write C program that implement stack (its operations) using Linked list
- Write a C program that uses Stack operations to evaluate postfix expression

#### Exercise -7 (Binary Tree)

Write a recursive C program for traversing a binary tree in preorder, inorder and postorder.

#### Exercise -8 (Binary Search Tree)

- Write a C program to Create a BST
- Write a C program to insert a node into and delete a node from a BST.

### Text Books:

- Data Structures Using C. 2<sup>nd</sup> Edition. Reema Thareja, Oxford.
- Data Structures and algorithm analysis in C, 2<sup>nd</sup>ed, Mark Allen Weiss.

### Reference Books:

- Fundamentals of Data Structures in C, 2nd Edition, Horowitz, Sahni, Universities Press.
- Data Structures: A PseudoCode Approach, 2/e, Richard F. Gilberg, Behrouz A. Forouzon, Cengage.
- Data Structures with C, Seymour Lipschutz TMH



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**e-Resources:**

- 1) <http://algs4.cs.princeton.edu/home/>
- 2) [https://faculty.washington.edu/jstraub/dsa/Master\\_2\\_7a.pdf](https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf)



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**MINOR COURSES**

**PART B**



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| PART B                                  | Minor Course | L | T | P | C |
|---|--------------|---|---|---|---|
|   |              | 3 | 0 | 2 | 4 |
| OBJECT ORIENTED PROGRAMMING THROUGH C++ |              |   |   |   |   |

**Course Objectives:**

- Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
- Understand dynamic memory management techniques using pointers, constructors, destructors
- Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
- Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
- Demonstrate the use of various OOPs concepts with the help of programs

**Course Outcomes:**

By the end of the course, the student

- Classify object oriented programming and procedural programming
- Apply C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling
- Build C++ classes using appropriate encapsulation and design principles
- Apply object oriented or non-object oriented techniques to solve bigger computing problems

**UNIT I**

Introduction to C++: Difference between C and C++, Evolution of C++, The Object Oriented Technology, Disadvantage of Conventional Programming, Key Concepts of Object Oriented Programming, Advantage of OOP, Object Oriented Language.

**UNIT II**

Classes and Objects & Constructors and Destructor: Classes in C++, Declaring Objects, Access Specifiers and their Scope, Defining Member Function, Overloading Member Function, Nested class, Constructors and Destructors, Introduction, Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments parameterized Constructor, Destructors, Anonymous Objects.

**UNIT III**

Operator Overloading and Type Conversion & Inheritance: The Keyword Operator, Overloading Unary Operator, Operator Return Type, Overloading Assignment Operator (=), Rules for Overloading Operators, Inheritance, Reusability, Types of Inheritance, Virtual Base Classes- Object as a Class Member, Abstract Classes, Advantages of Inheritance, Disadvantages of Inheritance.

**UNIT IV**

Pointers & Binding Polymorphisms and Virtual Functions: Pointer, Features of Pointers, Pointer Declaration, Pointer to Class, Pointer Object, The this Pointer, Pointer to Derived Classes and Base Class, Binding Polymorphisms and Virtual Functions, Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Virtual Destructor.

**UNIT V**

Generic Programming with Templates & Exception Handling: Definition of class Templates, Normal Function Templates, Over Loading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked Lists with Templates, Exception Handling, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements, Specifying Exceptions.



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Overview of Standard Template Library, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

**List of Experiments:**

**Exercise -1 (Classes Objects)**

Create a Distance class with:

- feet and inches as data members
- member function to input distance
- member function to output distance
- member function to add two distance objects

1. Write a main function to create objects of DISTANCE class. Input two distances and output the sum.
2. Write a C++ Program to illustrate the use of Constructors and Destructors (use the above program.)
3. Write a program for illustrating function overloading in adding the distance between objects (use the above problem)

**Exercise – 2 (Access)**

Write a program for illustrating Access Specifiers public, private, protected

1. Write a program implementing Friend Function
2. Write a program to illustrate this pointer
3. Write a Program to illustrate pointer to a class

**Exercise -3 (Operator Overloading)**

1. Write a program to Overload Unary, and Binary Operators as Member Function, and Non Member Function.
2. Write a c ++ program to implement overloading assignment = operator

**Exercise -4 (Inheritance)**

Write C++ Programs and incorporating various forms of Inheritance

- i) Single Inheritance
- ii) Hierarchical Inheritance
- iii) Multiple Inheritances
- iv) Multi-level inheritance
- v) Hybrid inheritance

**Exercise -5(Templates, Exception Handling)**

1. Write a C++ Program to illustrate template class
2. Write a Program for Exception Handling Divide by zero
3. Write a Program to rethrow an Exception

**Exercise -6**

1. Write a C++ program illustrating user defined string processing functions using pointers (string length, string copy, string concatenation)
2. Write a C++ program illustrating Virtual classes & virtual functions.
3. Write C++ program that implement Bubble sort, to sort a given list of integers in ascending order

**Text Books:**

- 1) A First Book of C++, Gary Bronson, Cengage Learning.
- 2) The Complete Reference C++, Herbert Schildt, TMH.



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**Reference Books:**

- 1) Object Oriented Programming C++, Joyce Farrell, Cengage.
- 2) C++ Programming: from problem analysis to program design, DS Malik, Cengage Learning
- 3) Programming in C++, Ashok N Kamthane, Pearson 2<sup>nd</sup> Edition

**e- Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105151/>
- 2) <https://github.com/topics/object-oriented-programming>



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|                             |              |   |   |   |   |
|-----------------------------|--------------|---|---|---|---|
| PART B                      | Minor Course | L | T | P | C |
|                             |              | 3 | 0 | 2 | 4 |
| DATA ANALYTICS USING PYTHON |              |   |   |   |   |



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| PART B                  | Minor Course | L | T | P | C |
|-------------------------|--------------|---|---|---|---|
|                         |              | 4 | 0 | 0 | 4 |
| ARTIFICIAL INTELLIGENCE |              |   |   |   |   |

**Course Objectives:** The student will be able to

- Know the methodology of Problem solving
- Implement basic AI algorithms
- Design and carry out an empirical evolution of different algorithms on a problem formalization

**Course Outcomes (COs):** At the end of the course, student will be able to

- Understand the fundamental concepts in Artificial Intelligence
- Analyze the applications of search strategies and problem reductions
- Apply the mathematical logic concepts.
- Develop the Knowledge representations in Artificial Intelligence.
- Explain the Fuzzy logic systems.

**UNIT I:**

**Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI.

**UNIT II:**

**Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem

**Search Strategies:** exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction

**UNIT III:**

**Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, predicate logic

**UNIT IV:**

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR

**Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure.

**UNIT V:**

**Expert system and applications:** Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools.

**Text Books:**

1. Artificial Intelligence, Saroj Kaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2<sup>nd</sup> ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence, Rich, Kevin Knight, Shiv Shankar B Nair, 3<sup>rd</sup> ed, TMH
4. Introduction to Artificial Intelligence, Patterson, PHI





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**Reference Books:**

1. Artificial intelligence, structures and Strategies for Complex problem solving, -George F Luger, 5<sup>th</sup> ed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier



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| PART B                     | Minor Course | L | T | P | C |
|----------------------------|--------------|---|---|---|---|
|                            |              | 3 | 0 | 2 | 4 |
| UNIX AND SHELL PROGRAMMING |              |   |   |   |   |

**Course Objectives:**

Understanding the shell commands, shell programming, system calls of files and processes, signals, inter-process communication concepts and programming, TCP and UDP.

**Course Outcomes:** After finishing this course student will be able to:

- Gain good knowledge on Unix commands and awareness of shell programming
- Know about different system calls for files and directories
- Ability to know the working of processes and signals
- Application of client server program for IPC
- Knowledge about socket programming

**UNIT-I:**

Introduction, Architecture of unix, Responsibilities of shell, unix file system, vi editor. **Unix commands:** Some Basic Commands, file utilities, process utilities, text processing utilities, network utilities, disk utilities, backup utilities, Security by file permissions.

**UNIT-II:**

**Shell Programming:** shell variables, The Export command, The Profile File a Script Run During starting, The First Shell Script, The read command, Positional Parameters, The \$? Variable, Knowing the exit Status- More about the Set Command, The Exit command, Branching Control Structures, Loop Control Structures, The Continue and Break Statement- The Expr Command, Performing Integer Arithmetic- Real Arithmetic in Shell Programs- The here Document(<<), The Sleep Command, Debugging Scripts, The Script command, The Eval command, The Exec Command, Sample programs.

**UNIT-III:**

**Files** - Introduction, file descriptors, open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, links-soft and hard links-symlink, link, unlink.

**UNIT IV:**

**Directories**-Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT V:**

**Process Control:** process identifiers, fork function, vfork function, exit function, wait and waitpid functions, exec functions, user identification. **Signals:** signal handling using signal function, kill and raise, alarm, pause, abort and sleep functions.

**List of Experiments:**

- 1)a) Study of Unix/Linux general purpose utility command list: man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.
- b) Study of vi editor
- c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system
- d) Study of Unix/Linux file system (tree structure)
- e) Study of .bashrc, /etc/bashrc and Environment variables.



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- 2) Write a C program that makes a copy of a file using standard I/O, and system calls
- 3) Write a C program to emulate the UNIX `ls -l` command.
- 4) Write a C program that illustrates how to execute two commands concurrently with a command pipe.  
Ex: - `ls -l | sort`
- 5) Implementation of `fork ()`, `wait ()`, `exec()` and `exit ()`, System calls

**Text Books:**

1. Unix the ultimate guide, 3<sup>rd</sup> edition, Sumitabha Das, TMH.
2. Advanced programming in the Unix environment by W. Richard Stevens.
3. Unix network programming by W. Richard Stevens.

**Reference Books:**

1. Introduction to Unix and shell programming, Venkateshmurthy
2. Unix and shell programming by B.M. Harwani, OXFORD university press.



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| PART B          | Minor Course | L | T | P | C |
|-----------------|--------------|---|---|---|---|
|                 |              | 4 | 0 | 0 | 4 |
| CLOUD COMPUTING |              |   |   |   |   |

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

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

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNIT I:**

**Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNIT II:**

**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNIT III:**

**Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV:**

**Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNIT V:**

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

1. Distributed and Cloud Computing, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.



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**Reference Books:**

4. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, University Press
5. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
6. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH



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**Suggested Courses for Honors Program**



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| II Year - II Semester                         | Honors Course | L | T | P | C |
|---|---------------|---|---|---|---|
|   |               | 4 | 0 | 0 | 4 |
| MATHEMATICS FOR MACHINE LEARNING<br>(AI & ML) |               |   |   |   |   |

**Course Objectives:**

The main objectives of this course is to make student understand and apply the basic mathematical concepts that are essential for machine learning algorithms

**Course Outcomes:**

By the end of the course, the student will be able to

- understand the basic notions of machine learning and of the related basic mathematical tools;
- comprehend the basic concepts and techniques of convex optimization
- have a good knowledge of the statistical and computational properties of some well known machine learning algorithms;
- implement machine learning algorithms on synthetic and real data sets using mathematical concepts like linear algebra, probability and calculus

**UNIT-I**

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces

**UNIT-II**

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

**UNIT-III**

Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny

**UNIT-IV**

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

**UNIT-V**

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform  
 Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

**Text Books:**

1. “Mathematics for Machine Learning”, Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2<sup>nd</sup> Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.



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**Reference Books:**

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.




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|   | Honors Course | L | T | P | C |
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|   |               | 4 | 0 | 0 | 4 |
| TEXT MINING AND TIME SERIES ANALYSIS<br>(AI & ML) |               |   |   |   |   |

**Course Objectives:** This course will cover the major techniques for mining and analyzing text data to discover interesting patterns, extract useful knowledge, and support decision making, with an emphasis on statistical approaches that can be generally applied to arbitrary text data in any natural language with no or minimum human effort. Develop the skills needed to do empirical research in fields operating with time series data sets. The course aims to provide students with techniques and receipts for estimation and assessment of quality of economic models with time series data.

**Course Outcomes:**

After completing the course Student will be able to:

- Student will be aware of fundamental concepts of text mining, unsupervised information extraction.
- Student will be aware of text clustering algorithms like feature selection, distance-based clustering and latent semantic indexing.
- Student will be aware of Text classification algorithm and text mining techniques.
- Student should aware of all the characteristics of time series and measures of dependencies.
- Student will be able to understand the ARIMA Models.

**UNIT I:**

**Introduction to Text Mining:** Introduction, Algorithms for Text Mining, Information Extraction from Text: Introduction, Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction. Text Summarization Techniques: Extractive Summarization, Topic Representation Approaches, Influence of Context, Indicator Representation and Machine Learning for Summarization.

**UNIT II:**

**Text Clustering Algorithms:** Introduction, Feature Selection and Transformation Methods for Text Clustering, Distance-Based Clustering Algorithms, Word and Phrase-based Clustering, Probabilistic Document Clustering and Topic Modelling. Dimensionality Reduction and Topic Modelling: Latent Semantic Indexing, Topic Models and Dimension Reduction.

**UNIT III:**

**Text Classification Algorithms:** Introduction, Feature Selection for Text Classification, Decision Tree Classifiers, Rule-based Classifier, Probabilistic and Naïve Bayes Classifiers, Linear Classifier, Proximity-based Classifier, Meta-Algorithms for Text Classification, Probabilistic Models for Text Mining: Mixture models, Stochastic Processes in Bayesian Nonparametric Models, Graphical Models.

**UNIT IV:**

**Characteristics of Time Series:** Introduction, Nature of Time Series Data, Time Series Statistical Models, Measures of Dependence: Autocorrelation and Cross-Correlation, Stationary Time Series, Time Series Regression and Exploratory Data Analysis: Classical Regression, Exploratory Data Analysis, Smoothing.

**UNIT V:**

**ARIMA Models:** Introduction, Autoregressive Moving Average Models, Difference Equations, Autocorrelation and Partial Autocorrelation, Building ARIMA Models, Multiplicative Seasonal ARIMA Models, Spectral Analysis and Filtering: Cyclical Behaviour and Periodicity, Spectral Density, Periodogram and Discrete Fourier Transform, Nonparametric and Parametric Spectral Estimation, Linear Filters, Dynamic Fourier Analysis and Wavelets.



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**Text Books:**

1. Charu C. Aggarwal, Chengxing Zhai, “Mining Text Data”, Kluwer Academic Publishers, Springer, 2012.
2. Robert H. Shumway and David S. Stoffer, “Time Series Analysis and Its Applications with R Examples”, Springer, 2016.

**Reference Books:**

1. James D. Hamilton, Time Series Analysis, Princeton University Press, 2004.
2. Avishek Pal and PKS Prakash, Practical Time Series Analysis, Birmingham - Mumbai, 2017.
3. Box, G.E.P., G.M. Jenkins and G.C. Reinsel. n Time Series Analysis, Forecasting, and Control, 3rd ed. Englewood Cliffs, NJ: Prentice Hall, 1994.
4. Chan, N.H. Time Series: Applications to Finance. 2002, New York: Wiley.
5. Fuller, W.A. Introduction to Statistical Time Series, 2<sup>nd</sup> ed. New York: Wiley, 1996.



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>NATURAL LANGUAGE PROCESSING<br/>(AI &amp; ML)</b> |                      |          |          |          |          |

**Course Objectives:**

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

**Course Outcomes:** After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

**UNIT I:**

**Introduction :**Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

**UNIT II:**

**Word Level Analysis:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and Maximum Entropy models.

**UNIT III:**

**Syntactic Analysis :** Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures

**UNIT IV:**

**Semantics And Pragmatics:** Requirements for representation, First-Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selectional restrictions, Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods, Word Similarity using Thesaurus and Distributional methods.

**UNIT V:**

**Discourse Analysis And Lexical Resources :** Discourse segmentation, Coherence, Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm, Coreference Resolution, Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).



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**Text Books:**

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, OReilly Media, 2009.

**Reference Books:**

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkha and Fred J. Damerau, Handbook of Natural Language Processing, Second, Chapman and Hall/CRC Press, 2010. Edition
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.



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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>REINFORCEMENT LEARNING<br/>(AI &amp; ML)</b> |                      |          |          |          |          |

**Course Objectives:**

By the end of the class students should be able to:

- Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
- Given an application problem (e.g. from computer vision, robotics, etc), decide if it should be formulated as a RL problem; if yes be able to define it formally (in terms of the state space, action space, dynamics and reward model), state what algorithm (from class) is best suited for addressing it and justify your answer.

**Course Outcomes:**

By the end of this course, students should be able to do the following:

1. Learn how to define RL problems like Tic-Tac-Toe, Multi-arm.
2. Student will be able to understand the finite markov decision processes.
3. Student will be to Understand Monte Carlo Methods and how it is work with tabular methods to solve classical control problems
4. Student should aware of Eligibility Traces and Understand how to find with approximate solutions.
5. Explore imitation learning tasks and solutions
6. Recognize current advanced techniques and applications in RL

**UNIT I:**

**Reinforcement Learning Problem:** Introduction, Elements of Reinforcement Learning, Limitations and Scope, Tic-Tac-Toe, Multi-arm Bandits:  $n$ -Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit, Associative Search.

**UNIT II:**

**Finite Markov Decision Processes:** Agent-Environment Interface, Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation, Dynamic Programming: Policy- Evaluation, Improvement, Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming.

**UNIT III:**

**Monte Carlo Methods:** Monte Carlo- Prediction, Estimation of Action Values, Control, Control without Exploring Start, Temporal- Difference learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning, Games, Afterstates.

**UNIT IV:**

**Eligibility Traces:**  $n$ -Step TD Prediction, Forward and Backward View of TD( $\lambda$ ), Equivalences of Forward and Backward Views,  $sar(\lambda)$ , Watkin's Q( $\lambda$ ), Off-policy Eligibility Traces using Important Sampling, Variable  $\lambda$ .

**UNIT V:**

**Planning and Learning with Tabular Methods:** Models and Planning, Integrating Planning, Acting and Learning, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.



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**Text Book:**

1. Rich S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2015.
2. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone parisi, Reinforcement Learning Algorithms: Analysis and Applications, 1<sup>st</sup> Edition, Springer, 2021.

**Reference Books:**

1. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agent, 1<sup>st</sup> Edition, O'Reilly, 2020.
2. Kyriakos G. Vamvoudakis, Yan Wan, Frank, L. Lewis, Derya Cansever, Handbook of Reinforcement Learning and Control, 1<sup>st</sup> Edition, Springer, 2021.

**NPTEL Link:** Reinforcement Learning:  
[https://onlinecourses.nptel.ac.in/noc22\\_cs34/preview](https://onlinecourses.nptel.ac.in/noc22_cs34/preview)



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| II Year - II Semester                       | Honors Course | L | T | P | C |
|---|---------------|---|---|---|---|
|   |               | 4 | 0 | 0 | 4 |
| INTERNET OF THINGS<br>(Systems Engineering) |               |   |   |   |   |

**Course Objectives:**

The main objectives of this course are

- Vision and Introduction to Internet of Things (IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

**Course Outcomes (COs):**

At the end of the course, student will be able to

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

**UNIT I:**

**The Internet of Things:** An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

**UNIT II:**

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

**UNIT III:**

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

**UNIT IV:**

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

**UNIT V:**

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.



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**Text Books:**

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

**Reference Books:**

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things, CunoPfister , Oreilly





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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>DATA COMMUNICATIONS AND INFORMATION CODING THEORY</b><br><b>(Systems Engineering)</b> |                      |          |          |          |          |

**Course Objective:**

The objective of this course is to introduce the basic concepts of information theory and coding, including information, source coding, channel model, channel capacity, channel coding and so on.

**Course Outcomes:**

The students at the end of the course will be able to:

- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.
- Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.
- Implement the encoder and decoder of one block code or convolutional code using any program language

**UNIT I:**

Overview; Basic Concepts - Entropy and Mutual information; Lossless Source Coding – Source entropy rate; Kraft inequality; Huffman code; Asymptotic equipartition property; Universal coding; Noisy Channel Coding - Channel capacity

**UNIT II:**

Random channel codes; Noisy channel coding theorem for discrete memory-less channels; Typical sequences; Error exponents; Feedback; Continuous and Gaussian channels; Lossy Source Coding - Rate-Distortion functions; Random source codes; Joint source-channel coding and the separation theorem.

**UNIT III:**

Source coding- Text, Audio and Speech: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

**UNIT IV:**

Source coding- Image and Video: Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

**UNIT V:**

Error control coding- Block codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC Error control coding

**Text books:**

1. Mark Kelbert(Author), Yuri Suhov, Information Theory and Coding by Example, Cambridge University Press,2013



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**Reference books:**

1. Simon Haykin and Michael Moher, Communication Systems, 5th Edition, Wiley, 2010
2. T.M. & Thomas, J.A. (2006). Elements of information theory. New York: Wiley.
3. Ad'amek, Foundations of coding, Wiley Interscience, 1991.
4. T. M. Cover and J. A. Thomas, Elements of information theory, Wiley, 1991.



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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>SERVICE ORIENTED ARCHITECTURES</b><br><b>(Systems Engineering)</b> |                      |          |          |          |          |

**Course Objectives:**

- To gain understanding of the basic principles of service orientation
- To learn service oriented analysis techniques
- To learn technology underlying the service design
- To learn the concepts such as SOAP, Registering and Discovering Services.

**Course Outcomes:** At the end of this course, students are expected to gain the following learning:

1. Get the foundations and concepts of service based computing
2. Advocate the importance and means of technology alignment with business
3. Understanding the basic operational model of web services,
4. Gain the knowledge of key technologies in the service oriented computing arena
5. Apply and practice the learning through a real or illustrative project/case study.

**UNIT I**

**Software Architecture:** Need for Software Architecture, Objectives of Software Architecture, Types of Information Technology (IT) Architecture, Architectural Patterns and Styles

**Architecting Process for Software Applications:** Architectural Considerations, Architecting Process for Software Applications, Level 0: High-Level Architecture, Level 1: Solution Architecture Detailed Design

**UNIT II**

**SOA and MSA Basics:** Service Orientation in Daily Life, Evolution of SOA and MSA Service-oriented Architecture and Microservices architecture –Drivers for SOA, Dimensions of SOA, Conceptual Model of SOA, Standards And Guidelines for SOA, Emergence of MSA

**Service-Oriented Architecture:** Considerations for Enterprise-wide SOA, Strawman Architecture for Enterprise-wide SOA, Enterprise SOA Reference Architecture, Object-oriented Analysis and Design (OOAD) Process, Service-oriented Analysis and Design (SOAD) Process

**UNIT III**

**Service-Oriented Applications:** Considerations for Service-oriented Applications, Patterns for SOA, Pattern-based Architecture for Service-oriented Applications, Composite Applications, Composite Application Programming Model

**Service-Oriented Analysis and Design:** Need for Models, Principles of Service Design Non-functional Properties for Services, Design of Activity Services (or Business Services) Design of Data Services, Design of Client Services, Design of Business Process Services

**UNIT IV**

**Microservices Architecture:**

**Trend in SOA – Microservices Architecture (MSA):** Services Model for Cloud and Mobile Solutions, API Adoption on the Rise, Challenges and Takeways from SOA Implementations Architecture Trend – Microservices Architecture, Microservices Architecture in Action

**Cloud and MSA:** Cloud Services, Hybrid Cloud Services, Considerations for Hybrid Cloud Services, Cloud Services and MSA, MSA for SMAC Solutions



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## **UNIT V**

**Mobile and MSA:** Mobile Technologies, Types of Mobile Applications, MSA for mobile solutions Case Study: SOA – Loan Management System (LMS) PoC, MSA – APIary PoC

### **Text Book:**

1. Shankar Kambhampaty, Service - Oriented Architecture & Microservices Architecture, 3ed: For Enterprise, Cloud, Big Data and Mobile , ISBN: 9788126564064, Wiley.
2. Mark Richards, Microservices vs Service-Oriented Architecture, O'Reilly Media, Inc., 2016.

### **Reference Books:**

1. Thomas Erl, Services-Oriented Architecture: Concepts, Technology and Design, Prentice Hall, 2005.
2. Guido Schmutz, Peter Welkenbach, Daniel Liebhart, Service-Oriented Architecture: An Integration Blueprint, Packt Publisher, 2010.



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|   | Honors Course | L | T | P | C |
|---|---------------|---|---|---|---|
|   |               | 4 | 0 | 0 | 4 |
| DESIGN OF SECURE PROTOCOLS<br>(Systems Engineering) |               |   |   |   |   |

**Course Objectives:**

The main objective of this course is that to explore various protocols and design of various protocols with deeper security.

**Course Outcomes:**

By the end of the course Student will

- Get the exposure to various protocols.
- Gain knowledge on various secure mechanisms through set of protocols.
- Efficiently design new set of protocols.
- Learn Security issues and overcome means with protocols.

**UNIT – I:**

OSI:ISO Layer Protocols: Application Layer Protocols, TCP/IP, HTTP, SHTTP, LDAP, MIME, POP & POP3, RMON, SNMP. Presentation Layer Protocols, Light Weight Presentation Protocol Session layer protocols.

**UNIT – II:**

RPC protocols, transport layer protocols, ITOT, RDP, RUDP, TALI, TCP/UDP, compressed TCP. Network layer Protocols, routing protocols, border gateway protocol-exterior gateway protocol, internet protocol IPv4, IPv6, Internet Message Control Protocol, IRDP Transport Layer Security, TSL, SSL, DTLS

**UNIT – III:**

Data Link layer Protocol, ARP, In ARP, IPCP, IPv6CP, RARP, SLIP .Wide Area and Network Protocols, ATM protocols, Broadband Protocols, Point to Point Protocols, Other WAN Protocols, security issues.

**UNIT – IV:**

Local Area Network and LAN Protocols, ETHERNET Protocols, VLAN protocols, Wireless LAN Protocols, Metropolitan Area Network Protocol, Storage Area Network and SAN

**UNIT – V:**

Protocols, FDMA, WIFI and WIMAX Protocols, security issues. Mobile IP, Mobile Support Protocol for IPv4 and IPv6, Resource Reservation Protocol. Multicasting Protocol, VGMP, IGMP, MSDP .Network Security and Technologies and Protocols, AAA Protocols, Tunneling Protocols, Secured Routing Protocols, GRE- Generic Routing Encapsulation, IPSEC– Security.

**Text Books:**

1. Jawin: “Networks Protocols Handbook”, 3rd Edition, Jawin Technologies Inc., 2005.
2. Bruce Potter and Bob Fleck : “802.11 Security”, 1st Edition, O’Reilly Publications, 2002.

**Reference Books:**

1. Ralph Oppliger : “SSL and TSL: Theory and Practice”, 1st Edition, Arttech House, 2009.
2. Lawrence Harte: “Introduction to CDMA- Network services Technologies and Operations”, 1st Edition, Althos Publishing, 2004.
3. Lawrence Harte: “Introduction to WIMAX”, 1st Edition, Althos Publishing, 2005



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|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>NETWORK CODING<br/>(Systems Engineering)</b> |                      |          |          |          |          |

**Course Objectives:**

- Students will gain the understanding of core network programming by using sockets and transport layer protocols like TCP and UDP
- Students will gain the understanding of inter process communication and implementation of different forms of IPC in client-server environment
- Students will get an exposure to various application layer protocols which are designed using sockets and transport layer protocols

**Course Outcomes:**

By the end of the course, the student will be able to

- Explain the client-server paradigm and socket structures.
- Describe the basic concepts of TCP sockets and TCP echo client-server programs.
- Discuss the UDP sockets and UDP echo client-server programs.
- Explain Socket options and ability to understand IPC
- Apply the applications of sockets and demonstrate skill to design simple applications like FTP, TELNET etc.

**UNIT-I:**

Introduction to Network Programming: OSI model, transport layer protocols: TCP, UDP and SCTP, network architecture: client-server and peer-to-peer systems, Sockets-socket Address structures: IPv4, IPv6 and Generic-value result arguments, Byte ordering functions, Byte manipulation functions, Address conversion functions

**UNIT-II:**

TCP: introduction to TCP, TCP connection establishment and termination TIME\_WAIT State. Elementary TCP sockets, Socket, connect, bind, listen, accept, fork, exec function, concurrent servers, Close function, read and write functions

**UNIT-III:**

TCP echo client server program, getsockname and getpeername functions I/O multiplexing: I/O models, Select function, TCP echo server using select function, shutdown function, Poll function

**UNIT-IV:**

UDP: Introduction to UDP, difference between TCP and UDP, recvfrom( ) and sendto( ) functions, UDP echo client server program, UDP echo client server using select function. Socket Options: IPv4 socket options, IPv6 socket options

**UNIT-V:**

Socket Options: Generic socket options, TCP socket options. IPC: Introduction to IPC, forms of IPC, UNIX kernel support for pipes, FIFO, message queues, semaphores and shared memory Network programming concepts Implementation: FTP, ping, arp, SMTP, TELNET



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**Text Books:**

1. Unix Network programming, the socket networking API, W.Richard Stevens, bill fenner, Andrew m.rudoff ,PHI.

**References Books:**

1. Advanced programming in the UNIX environment, W.Richard Stevens, pearson education



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| II Year - II Semester                                  | Honors Course | L | T | P | C |
|--|---------------|---|---|---|---|
|  |               | 4 | 0 | 0 | 4 |
| PRINCIPLES OF CYBER SECURITY<br>(Information Security) |               |   |   |   |   |

**Course Objectives:**

- To learn threats and risks within context of the cyber security architecture.
- Student should learn and Identify security tools and hardening techniques.
- To learn types of incidents including categories, responses and timelines for response.

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

- Apply cyber security architecture principles.
- Demonstrate the risk management processes and practices.
- Appraise cyber security incidents to apply appropriate response
- Distinguish system and application security threats and vulnerabilities.
- Identify security tools and hardening techniques

**UNIT-I:**

**Introduction to Cyber Security**-Cyber security objectives, roles, differences between information security and cyber security, Cyber security principles-confidentiality, integrity, availability, authentication and non repudiation

**UNIT-II:**

**Information Security within Lifecycle Management**-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, **Risks & Vulnerabilities**-Basics of risk management, Operational threat environments, Classes of attacks

**UNIT-III:**

**Incident Response**-Incident categories, Incident response, Incident recovery, **Operational security protection**-Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management

**UNIT-IV:**

**Threat Detection and Evaluation Monitoring**-Vulnerability management, Security logs and alerts, Monitoring tools and appliances, **Analysis**-Network traffic analysis, packet capture and analysis

**UNIT-V:**

**Introduction to backdoor System and security**-Introduction to metasploit, backdoor, demilitarized zone (DMZ), Digital signature, Brief study on Hardening of operating system.

**Text Books:**

1. NASSCOM: Security Analyst Student Hand Book, Dec 2015
2. Information Security Management Principles, Updated Edition, [David Alexander](#), [Amanda Finch](#), [David Sutton](#), BCS publishers, June 2013

**Reference Books:**

1. Cyber Security Fundamentals-Cyber Security, Network Security and Data Governance Security, 2<sup>nd</sup> Edition, ISACA Publishers, 2019





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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>COMPUTATIONAL NUMBER THEORY</b><br><b>(Information Security)</b> |                      |          |          |          |          |

**Course Objectives:** This course will focus on designing efficient algorithms (and providing complexity analysis) for the most important problems from number theory, with major applications in coding theory and cryptography.

**Course Outcomes:**

Upon completing the course the student will be able to

- understand with basics of number theory and its applications.
- demonstrate the arithmetic of finite fields, polynomials.
- analyze the elliptic curves, testing and factorization.
- Student will be able to solve the discrete logarithms and large sparse linear systems.
- Student will be able to apply the skills for writing programs of cryptography algorithms.

**UNIT I:**

**Arithmetic of Integers:** Basic Arithmetic Operations, GCD, Congruences and Modular Arithmetic, Linear Congruences, Polynomial Congruences, Quadratic Congruences, Multiplicative Orders, Continued Fractions, Prime Number Theorem and Riemann Hypothesis, Running Times of Arithmetic Algorithms.

**UNIT II:**

**Arithmetic of Finite Fields:** Existence and Uniqueness of Finite Fields, Representation of Finite Fields, Implementation of Finite Field Arithmetic, Arithmetic of Polynomials: polynomials over Finite Fields, Finding Roots of Polynomials over Finite Fields, Factoring Polynomials over Finite Fields, Properties of Polynomials with Integer Coefficients, Factoring Polynomials with Integer Coefficients.

**UNIT III:**

**Arithmetic of Elliptic Curves:** Elliptic Curve, Elliptic-Curve Group, Elliptic Curve over Finite Fields, Pairing on Elliptic Curves, Elliptic-Curve Point Counting, Primality Testing: Introduction, Probabilistic Primality Testing, Deterministic Primality Testing, Primality Testing for Number of Special Forms.

**UNIT IV:**

**Integer Factorization:** Trial Division, Pollard's Rho Method, Pollard's  $p-1$  Method, Dixon's Method, CFRAC Method, Quadratic Sieve Method, Cubic Sieve Method, Elliptic Curve Method, Number-Field Sieve Method, Discrete Logarithms: Square-Root Methods, Algorithms: Prime Fields, Fields of Characteristic Two, General Extension Fields, Elliptic Curves(ECDLP).

**UNIT V:**

**Large Sparse Linear Systems:** Structured Gaussian Elimination, Lanczos Method, Wiedemann Method, Block Methods

**Text Books:**

1. Abhijit Das, Computational Number Theory, CRC Hall, 1<sup>st</sup> Edition, 2013.
2. T. H. Cormen, C. E. Leiserson, R. Rivest and C. Stein, Introduction to Algorithms, Prentice Hall India, 2nd Edition, 2002.



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**Reference Books:**

1. Victor Shoup, A Computational Introduction to Number Theory and Algebra, 2<sup>nd</sup> Edition, Cambridge University Press, 2008.
2. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press, 2021.
3. M. Mignotte, Mathematics for computer algebra, Springer-Verlag, 1992.



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|---|----------------------|----------|----------|----------|----------|
|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>CRYPTANALYSIS</b><br><b>(Information Security)</b> |                      |          |          |          |          |



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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>ELLIPTIC CURVE CRYPTOGRAPHY<br/>(Information Security)</b> |                      |          |          |          |          |



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>INTRODUCTION TO QUANTUM COMPUTING AND QUANTUM<br/> CRYPTOGRAPHY<br/> (Information Security)</b> |                      |          |          |          |          |



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>PUBLIC KEY INFRASTRUCTURE AND TRUST MANAGEMENT</b><br><b>(Information Security)</b> |                      |          |          |          |          |

**Course objectives:**

The course is designed to train the graduates in depth understanding of Public Key Cryptography, Public key Infrastructure, security credentials and design new or modify existing cryptographic techniques.

**Course Outcomes:**

Graduates after completing the course shall gain:

- In depth understanding of Public key cryptography and Infrastructure.
- Ability to design and analyze Public Key cryptographic techniques.
- Ability to solve network security issues in real time applications.
- Ability to take up doctoral level research work in security.

**UNIT I:**

**Public key infrastructure:** components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates.

**UNIT II:**

**PKI Services:** Authentication, Integrity and Confidentiality, Mechanisms, Secure Communication, Secure Time Stamping, Non-Repudiation, Privilege Management, Certificate policies, Certificate Authority, Registration Authority.

**UNIT III:**

**Key and Certificate Management:** Key/Certificate Life Cycle Management, Certificate Revocation: Periodic Public Mechanisms, performance, Scalability and Timeliness, Multiple Key pairs, Key Pair Uses, Real-World Difficulties, Independent Certificate Management.

**UNIT IV:**

**Trust Models:** Strict Hierarchy of Certification Authorities, Distributed Trust Architecture, Web Model, User-Centric Trust, Cross-Certification, Entity Naming, Certificate Path processing, PKI Information Dissemination: Repositories and Techniques, private Dissemination, Public and Repositories, In-Band Protocol Exchange.

**UNIT V:**

**PKI Standards:** Introduction, Major Standards Activities, X.509, PKIX, X.500, LDAP, ISO TC68, ANSI X9f, S/MIME, IPsec, TLS, SPKI, OpenPGP, EDIFACT.

**Text Books:**

1. Carlisle Adams, Steve Lloyd, Understanding Public-Key Infrastructure: Concepts, Standards, and Deployment Considerations, Sams, 1999.
2. [John R. Vacca](#), Public Key Infrastructure, Building Trusted Applications and Web Services, Auerbach Publications, 2004.



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**Reference Books:**

1. Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education, Prentice Hall, 2011.
2. Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill.



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|---|----------------------|----------|----------|----------|----------|
|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>INFORMATION SECURITY ANALYSIS AND AUDIT</b><br><b>(Information Security)</b> |                      |          |          |          |          |

**Course Objectives:**

- Understanding and knowledge of Security Auditing, and introduce the Threats and defense in the systems.
- Acquiring the knowledge on Evidence collection and evaluation techniques.

**Course Outcomes:**

At the end of the course, student will be able to

- Illustrate the fundamental concepts of information security and systems auditing
- Analyze the latest trend of computer security threats and defense
- Identify security weaknesses in information systems, and rectify them with appropriate security mechanisms
- Explain the security controls in the aspects of physical, logical and operational security control and case studies
- Evaluate the security of information systems

**UNIT-I:**

**Overview of Information System Auditing-** Effect of Computers on Internal Controls, Effects of Computers on Auditing, Foundations of information Systems Auditing, Conducting an Information Systems Audit.

**UNIT-II:**

**The management Control Framework-I-** Introduction, Evaluating the planning Function, Leading Function, Controlling Function, Systems Development Management Controls, Approaches to Auditing Systems Development, Normative Models of the Systems Development Process, Evaluating the Major phases in the Systems Development Process, Programming Management Controls, Data Resource Management Controls.

**UNIT-III:**

**The Management Control Framework-II-** Security Management Controls, Operations management Controls Quality assurance Management Controls, Case Studies.

**UNIT-IV:**

**Evidence Collection-** Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires, and Control Flowcharts. Performance Management tools- Case Studies.

**UNIT-V:**

**Evidence Evaluation-** Evaluating Asset Safeguarding and Data Integrity, Evaluating System, Effectiveness, Evaluating System Efficiency, Information Systems Audit and Management: Managing the Information Systems Audit Function.





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**Text Book:**

1. Information Systems Control and Audit, 1<sup>st</sup> Edition, Ron Weber, Pearson Education, 2013

**Reference Book:**

1. Information System Audit and Assurance, D P Dube, TMH, New Delhi, 2008



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>CLOUD AND IOT SECURITY</b><br><b>(Information Security)</b> |                      |          |          |          |          |

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

- Discuss about Security Requirements in IoT Architecture
- Explain Random number generation
- Demonstrate Authorization with Publish / Subscribe schemes
- Identify Lightweight and robust schemes for Privacy protection
- Explain about IoT cloud security architecture

**UNIT I:**

**Introduction: Securing Internet of Things:** Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications. Security Architecture in the Internet of Things, Security Requirements in IoT, Insufficient Authentication /Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability, Attacks Specific to IoT. Vulnerabilities, Secrecy and Secret-Key Capacity, Authentication/Authorization for Smart Devices, Transport Encryption, Attack, Fault trees

**UNIT II:**

**Cryptographic Fundamentals for IoT:** Cryptographic primitives and its role in IoT, Encryption and Decryption, Hashes, Digital Signatures, Random number generation, Cipher suites, key management fundamentals, cryptographic controls built into IoT messaging and communication protocols.

**UNIT III:**

**Identity & Access Management Solutions for IoT:** Identity lifecycle, authentication credentials, IoT IAM infrastructure, Authorization with Publish / Subscribe schemes and access control

**UNIT IV:**

**Privacy Preservation and Trust Models for IoT:** Concerns in data dissemination, Lightweight and robust schemes for Privacy protection, Trust and Trust models for IoT, self-organizing Things, Preventing unauthorized access.

**UNIT V:**

**Cloud Security for IoT:** Cloud services and IoT, offerings related to IoT from cloud service providers, Cloud IoT security controls, enterprise IoT cloud security architecture, New directions in cloud enabled IoT computing

**Text Books:**

1. Practical Internet of Things Security (Kindle Edition) by Bria Russell, Drew VanDuren

**References Books:**

1. Securing the Internet of Things, Elsevier
2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>WEB SECURITY</b><br><b>(Information Security)</b> |                      |          |          |          |          |

**Course Objectives:**

- Underlying security principles of the web
- Overview of concrete threats against web applications
- Insights into common attacks and countermeasures
- Current best practices for secure web applications

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

- Demonstrate security concepts, security professional roles, and security resources in the context of systems and security development life cycle
- Justify applicable laws, legal issues and ethical issues regarding computer crime
- Explain the business need for security, threats, attacks, top ten security vulnerabilities, and secure software development
- Apply information security policies, standards and practices, the information security blueprint
- Analyze and describe security requirements for typical web application scenario

**UNIT-I:**

**Introduction-**A web security forensic lesson, Web languages, Introduction to different web attacks, Overview of N-tier web applications, Web Servers-Apache, IIS.

**UNIT-II:**

**Securing the Communication Channel-** Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS, and dealing with the impact on your application, Insights into the latest evolutions for HTTPS deployments.

**UNIT-III:**

**Web Hacking Basics-** HTTP & HTTPS URL, Web under the Cover Overview of Java security Reading the HTML source, Applet Security Servlets Security Symmetric and Asymmetric Encryptions, Network security Basics, Firewalls & IDS.

**UNIT-IV:**

**Securely Handling Untrusted Data-**Investigation of injection attacks over time, Understanding the cause behind both server-side and client-side injection attacks, Execution of common injection attacks, and implementation of various defenses.

**UNIT-V:**

**Preventing Unauthorized Access-**Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process prevent authorization bypasses and harden session management mechanisms, Securing Large Applications, Cyber Graffiti.

**Text Books:**

1. Web Hacking: Attacks and Defense, Latest Edition , McClure, Stuart, Saumil Shah, and Shreeraj Shah, Addison Wesley, 2003
2. Professional Java Security, 1.3 Edition, Garms, Jess and Daniel Somerfield, Wrox, 2001



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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>BLOCK CHAIN ARCHITECTURE DESIGN AND USE CASES</b><br><b>(Information Security)</b> |                      |          |          |          |          |

**Course Objectives:**

By the end of the course, students will be able to

- Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

**Course Outcomes:**

At the end of the course, student will be able to

- Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- Identify the risks involved in building Block chain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Blockchain implementations and Understand Crypto currency markets
- Examine how to profit from trading crypto currencies.

**UNIT I**

Introduction, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain.

Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution, Consortia, Forks, Public Blockchain Environments, Type of Players in Blockchain Ecosystem, Players in Market.

**UNIT II**

Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on blockchain, data storage on blockchain, wallets, coding on blockchain: smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.

**UNIT III**

Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, Types of Blockchain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Blockchain Solutions, Architecture Considerations, Architecture with Blockchain Platforms, Approach for Designing Blockchain Applications.

**UNIT IV**

Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts



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**UNIT V**

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application.

Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Blockchain with IoT and AI/ML Quantum Computing and Blockchain, Initial Coin Offering, Blockchain Cloud Offerings, Blockchain and its Future Potential.

**Text Books:**

- 1) Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
- 2) Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain” , O’Reilly

**Reference Books:**

- 1) Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
- 2) Blockchain: Blueprint for a New Economy, Melanie Swan, O’Reilly

**e-Resources:**

- 1) <https://github.com/blockchainedindia/resources>



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## DEPARTMENT OF INFORMATION TECHNOLOGY

| II Year - II Semester                | Honors Course | L | T | P | C |
|--------------------------------------|---------------|---|---|---|---|
|                                      |               | 4 | 0 | 0 | 4 |
| DATA VISUALIZATION<br>(Data Science) |               |   |   |   |   |

### Course Objectives:

The main objective of this course is to make it easier to identify patterns, trends and outliers in large data sets

### Course Outcomes:

On completion of this course, the student will be able to

- Identify and recognize visual perception and representation of data.
- Illustrate about projections of different views of objects.
- Apply various Interaction and visualization techniques.
- Analyze various groups for visualization.
- Evaluate visualizations

### UNIT-I:

**Introduction to Data Visualizations and Perception:** Introduction of visual perception, visual representation of data, Gestalt principles, Information overload.

### UNIT-II :

**Visual Representations:** Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

### UNIT-III :

**Classification of Visualization Systems:** Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

### UNIT-IV :

**Visualization of Groups:** Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

### UNIT-V :

**Visualization of Volumetric Data And Evaluation of Visualizations:** Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

### Text Books:

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2<sup>nd</sup> edition, A K Peters, Ltd 2015.

### Reference Books:

1. Tamara Munzner, Visualization Analysis & Design ,1<sup>st</sup> edition, AK Peters Visualization Series 2014
2. Scott Murray, Interactive Data Visualization for the Web ,2<sup>nd</sup> Edition, 2017



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|  | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|  |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>STATISTICAL FOUNDATIONS FOR DATA SCIENCE</b><br><b>(Data Science)</b> |                      |          |          |          |          |

**Course Objectives:**

The course will introduce the fundamental concepts of probability and statistics required for a program in data science

**Course outcomes:**

By the end of the course, the student will be able to

- Use the statistical concepts in the field of data science.
- Employ the techniques and methods related to the area of data science in variety of applications.
- Apply logical thinking to understand and solve the problem in context.
- Explore statistical learning methods and their application to modern problems in science, industry, and society.
- Build analytics pipelines for regression problems and classification problems

**UNIT I:**

Basics of Data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems.

**UNIT II:**

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Expectations and moments; Covariance and correlation; Statistics and sampling distributions; Hypothesis testing of means, proportions, variances and correlations; Confidence (statistical) intervals; Correlation functions; White-noise process

**UNIT III:**

Probabilistic formulations of prediction problems: Plug-in estimators, empirical risk minimization, Linear threshold functions, perceptron algorithm, Risk bounds, Concentration inequalities, Uniform convergence, Rademacher averages; combinatorial dimensions, Convex surrogate losses for classification, Linear regression, Regularization and linear model selection, Feature Selection Methods, Cross Validation methods.

**UNIT IV:**

Game-theoretic formulations of prediction problems, High Dimensional methods, Lasso, Ridge Regression, Dimensionality Reduction, Minimax strategies for log loss, linear loss, and quadratic loss, Universal portfolios, Online convex optimization.

**UNIT V:**

Neural networks: Stochastic gradient methods, Combinatorial dimensions and Rademacher averages, Hardness results for learning, Efficient learning algorithms.



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**Text Books:**

1. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010
2. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.
3. James, G., Witten, D., Hastie, T., Tibshirani, R. An Introduction to Statistical Learning with Applications in R, Springer, 2013.

**Reference Books:**

1. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer, 2009.





# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

## DEPARTMENT OF INFORMATION TECHNOLOGY

|  |               |   |   |   |   |
|--|---------------|---|---|---|---|
|  | Honors Course | L | T | P | C |
|  |               | 4 | 0 | 0 | 4 |
| MINING MASSIVE DATA SETS<br>(Data Science) |               |   |   |   |   |

**Course Objective:** The course will discuss data mining and machine learning algorithms for analyzing very large amounts of data. The emphasis will be on MapReduce and [Spark](#) as tools for creating parallel algorithms that can process very large amounts of data.

### Course Outcomes:

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

- Discuss research directions in Mining Massive Datasets, such as similarity search, streaming data, clustering, and graph mining.
- Analyze policy, focusing on methods for mining massive datasets and potential policy and management applications, by synthesizing and summarizing the current state of the art, and facilitating discussion by posing questions, preliminary conclusions, and ideas to explore.
- Develop a research project relevant to Mining Massive Datasets and produce a report describing the project's background, methods, results, and conclusions.
- Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program.
- Good knowledge of Java and Python will be extremely helpful since most assignments will require the use of Spark

### UNIT I:

**Data Mining:** Data Mining, Statistical Limits on Data Mining, MapReduce: Distributed File Systems, MapReduce, Algorithms Using MapReduce, Extensions to MapReduce.

### UNIT II:

**Finding Similar Items:** Applications of Near-Neighbor Search, Shingling of Documents, Distance Measures, Theory of Locality-Sensitive Functions, Applications of LSH Hashing.

### UNIT III:

**Mining Data Streams:** Stream Data Model, Sampling Data in Streams, Filtering Streams, Link Analysis: PageRank, Efficient Computational of PageRank, Link Spam, Hubs and Authorities.

### UNIT IV:

**Frequent Itemsets:** Market-Based Model, Market Based and A-Priori Algorithm, Limited-Pass Algorithms, Clustering: Introduction, Hierarchical Clustering and K-means Algorithm, CURE Algorithm.

### UNIT V:

**Dimensionality Reduction:** Eigenvalues and Eigenvectors, Principal-Component Analysis, CUR Decomposition, Large-Scale Machine Learning: Machine Learning Model, Perceptrons, SVM's, Nearest Neighbors.

### Text Books:

1. Jure Leskovec, Anand Rajaraman, Jeffery D. Ullman, Mining of Massive Datasets, Cambridge University Press, 2014.
2. Pattern Recognition and Machine Learning. Christopher Bishop. Springer-Verlag New York. 2006.



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**Reference Books:**

1. Machine Learning: A Probabilistic Perspective. Kevin Murphy. MIT Press. 2012
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Trevor Hastie, Robert Tibshirani, Jerome Friedman. Springer. 2013



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|   | <b>Honors Course</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---|----------------------|----------|----------|----------|----------|
|   |                      | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |
| <b>MEDICAL IMAGE DATA PROCESSING</b><br><b>(Data Science)</b> |                      |          |          |          |          |

**Course Objectives:**

The course will provide the participants with an up-to-date background in current state-of-the-art in medical imaging and medical image analysis. The aim of the course is to show how to extract, model, and analyze information from medical data and applications in order to help diagnosis, treatment and monitoring of diseases through computer science.

**Course Outcomes:** At the End of the Course:

1. Student will be able to explain the basic concepts of Medical Imaging Technologies, Systems and Formation Principles.
2. Student will be able to analyze the Medical Image Storage and Processing.
3. Student will be able to visualize the MRI, NMR and Artifacts.
4. Student should expertise the Segmentation and Classification techniques on Medical Image Data.
5. Student will be able to analyze the Nuclear Imaging like PET, SPECT and 3D Images.

**UNIT I:**

**Introduction:** Introduction to Medical Imaging Technology, Systems, and Modalities. Brief History, Importance, Applications, Trends, Challenges. Medical Image Formation Principles: X-Ray physics, X-Ray generation, Attenuation, Scattering, Dose Basic Principles of CT, Reconstruction Methods, Artifacts, CT hardware.

**UNIT II:**

**Storage and Processing:** Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding, contrast enhancement, SNR characteristics; filtering; histogram modeling.

**UNIT III:**

**Visualization:** Medical Image Visualization Fundamentals of Visualization, Surface and Volume Rendering/Visualization, Animation, Interaction. Magnetic Resonance Imaging (MRI) Mathematics of MR, Spin Physics, NMR Spectroscopy, Imaging Principles and Hardware, Image Artifacts.

**UNIT IV:**

**Segmentation And Classification:** Medical Image Segmentation, Histogram-Based Methods, Region Growing and Watersheds, Markov Random Field Models, Active Contours, Model-Based Segmentation. Multi-Scale Segmentation, Semi-Automated Methods, Clustering-Based Methods, Classification-Based Methods, Atlas-Guided Approaches, Multi-Model Segmentation. Medical Image Registration Intensity-Based Methods, Cost Functions, Optimization Techniques.

**UNIT V:**

**Nuclear Imaging:** PET and SPECT Ultrasound Imaging Methods, Mathematical Principles, Resolution, Noise Effect, 3D Imaging, Positron Emission Tomography, Single Photon Emission Tomography, Ultrasound Imaging, Applications. Medical Image Search and Retrieval Current Technology in Medical Image Search, Content-Based Image Retrieval, New Trends: Ontologies, Applications, Other Applications Of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.



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**Text Books:**

1. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
2. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.

**Reference Books:**

1. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
2. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
3. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition 1, Prentice Hall, 2005.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.