

**AUTONOMOUS**

# **SYLLABUS**

**2025**

**I & II Year  
M.Tech in Computer Science & Engineering**

**MITE**



**Invent Solutions**

**MANGALORE INSTITUTE OF  
TECHNOLOGY & ENGINEERING**

# MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust<sup>®</sup>, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

## Institute Vision

*“To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**”*

## Institute Mission

*“To establish world class educational institutions in their respective domains, which shall be **Centers of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic, Sensitive and Demanding, Innovative and Practical, Theoretical and Pragmatic; ALL at the same time**”*

## Department Vision

*“To establish as a **Center of Excellence in Education and Research** in the field of Computer Science & Engineering for transforming the students into **Competent Professionals**”*

## Department Mission

- *Provide strong theoretical and practical background in Computer Science & Engineering and allied fields of Engineering.*
- *Provide excellent state of the art infrastructure and competent man power to facilitate the need based technical education to the students with ethical and social values.*
- *Encourage students to involve in Co-curricular and extracurricular activities.*
- *Promote Research and Innovation activities among the staff and students.*

## Program Educational Objectives (PEOs)

### Graduates of Computer Science and Engineering program will

- *Design, develop and maintain reliable software systems to satisfy the needs of customers.*
- *Do research and development to meet the challenges of changing technologies.*
- *Work in teams to fulfill the societal and industrial needs.*

## Program Specific Outcomes (PSOs)

### The graduates of the Computer Science and Engineering department will be able to

- *Design, develop, test and maintain the software systems that fulfill the needs of the industry and society*
- *Apply the concept of networking, data storage and computation to solve the real world problems*

## LIST OF COURSES

| Sl. No.                                        | Course Code | Course Title                                 | Semester |
|------------------------------------------------|-------------|----------------------------------------------|----------|
| <b>PROFESSIONAL CORE COURSES</b>               |             |                                              |          |
| 1                                              | 25CSPC501   | Advanced Algorithms                          | I        |
| 2                                              | 25CSPC502   | Data analytics using Python                  | I        |
| 3                                              | 25CSPC503   | Advances in Computer Networks                | I        |
| 4                                              | 25CSPC504   | Object Oriented Software Engineering         | I        |
| 5                                              | 25CSPC511   | Big Data Analytics                           | II       |
| 6                                              | 25CSPC512   | Artificial Intelligence and Machine Learning | II       |
| 7                                              | 25CSPC513   | Blockchain Technology                        | II       |
| <b>PROFESSIONAL ELECTIVE COURSES</b>           |             |                                              |          |
| 8                                              | 25CSPE521   | Advances in Digital Image Processing         | II       |
| 9                                              | 25CSPE522   | Advances in Computer Architecture            | II       |
| 10                                             | 25CSPE523   | Advances in Wireless Sensor Networks         | II       |
| 11                                             | 25CSPE531   | Cryptography and Network Security            | II       |
| 12                                             | 25CSPE532   | Compiler Optimization Techniques             | II       |
| 13                                             | 25CSPE533   | Pattern Recognition                          | II       |
| <b>HUMANITIES &amp; SOCIAL SCIENCE COURSES</b> |             |                                              |          |
| 14                                             | 25HMCC506   | Research Methodology and Technical Writing   | I        |

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| I Semester |             |                                                            |                          |                     |                     |          |                     |                   |           |           |             |         |
|------------|-------------|------------------------------------------------------------|--------------------------|---------------------|---------------------|----------|---------------------|-------------------|-----------|-----------|-------------|---------|
| Sl. No     | Course Code | Course Title                                               | Category                 | Teaching Department | Teaching Hours/Week |          |                     | Examinations      |           |           |             | Credits |
|            |             |                                                            |                          |                     | Theory Lecture      | Tutorial | Practical Component | Duration in hours | CIE Marks | SEE Marks | Total Marks |         |
| 1          | 25CSPC501   | Advanced Algorithms                                        | Professional Core Course | CSE                 | 03                  | -        | 02                  | 3                 | 50        | 50        | 100         | 4       |
| 2          | 25CSPC502   | Data Analytics using Python                                | Professional Core Course |                     | 03                  | -        | 02                  | 3                 | 50        | 50        | 100         | 4       |
| 3          | 25CSPC503   | Advances in Computer Networks                              | Professional Core Course |                     | 03                  | -        | 00                  | 3                 | 50        | 50        | 100         | 3       |
| 4          | 25CSPC504   | Object Oriented Software Engineering                       | Professional Core Course |                     | 03                  | -        | 00                  | 3                 | 50        | 50        | 100         | 3       |
| 5          | 25CSSE505   | Seminar on Recent Trends in Computer Science & Engineering | Skill Enhancement        |                     | -                   | -        | 04                  | -                 | 100       | -         | 100         | 2       |
| 6          | 25HMCC506   | Research Methodology and Technical Writing                 | Humanities               |                     | 01                  | -        | 02                  | 2.5               | 50        | 50        | 100         | 2       |
| Total      |             |                                                            |                          |                     | 13                  | -        | 10                  | 14.5              | 350       | 250       | 600         | 18      |

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| II Semester |             |                                              |                                     |                     |                     |          |                     |                   |           |           |             |         |
|-------------|-------------|----------------------------------------------|-------------------------------------|---------------------|---------------------|----------|---------------------|-------------------|-----------|-----------|-------------|---------|
| Sl. No      | Course Code | Course Title                                 | Category                            | Teaching Department | Teaching Hours/Week |          |                     | Examinations      |           |           |             | Credits |
|             |             |                                              |                                     |                     | Theory Lecture      | Tutorial | Practical Component | Duration in hours | CIE Marks | SEE Marks | Total Marks |         |
| 1           | 25CSPC511   | Big Data Analytics                           | Professional Core Course            | CSE                 | 03                  | -        | 02                  | 3                 | 50        | 50        | 100         | 4       |
| 2           | 25CSPC512   | Artificial Intelligence and Machine Learning | Professional Core Course            |                     | 03                  | -        | 02                  | 3                 | 50        | 50        | 100         | 4       |
| 3           | 25CSPC513   | Blockchain Technology                        | Professional Core Course            |                     | 04                  | -        | 00                  | 3                 | 50        | 50        | 100         | 4       |
| 4           | 25CSPE52X   | Professional Elective 1                      | Discipline Specific Elective Course |                     | 04                  | -        | 00                  | 3                 | 50        | 50        | 100         | 4       |
| 5           | 25CSPE53X   | Professional Elective 2                      | Discipline Specific Elective Course |                     | 04                  | -        | 00                  | 3                 | 50        | 50        | 100         | 4       |
| 6           | 25CSSE514   | Mini Project                                 | Skill Enhancement                   |                     | 00                  | -        | 06                  | -                 | 100       | -         | 100         | 3       |
| Total       |             |                                              |                                     |                     | 16                  |          | 10                  | 15                | 350       | 250       | 600         | 23      |

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| Professional Elective 1              |           |
|--------------------------------------|-----------|
| Advances in Digital Image Processing | 25CSPE521 |
| Advances in Computer Architecture    | 25CSPE522 |
| Advances in Wireless Sensor Networks | 25CSPE523 |

| Professional Elective 2           |           |
|-----------------------------------|-----------|
| Cryptography and Network Security | 25CSPE531 |
| Compiler Optimization Techniques  | 25CSPE532 |
| Pattern Recognition               | 25CSPE533 |

| III Semester |             |                            |                          |                |                       |          |                     |                   |           |           |             |         |
|--------------|-------------|----------------------------|--------------------------|----------------|-----------------------|----------|---------------------|-------------------|-----------|-----------|-------------|---------|
| Sl.No        | Course Code | Course Title               | Category                 | Teaching Dept. | Teaching Hours/Week   |          |                     | Examinations      |           |           |             | Credits |
|              |             |                            |                          |                | Theory Lecture        | Tutorial | Practical Component | Duration in hours | CIE Marks | SEE Marks | Total Marks |         |
| 1            | 25CSPC601   | Deep Learning              | Professional Core Course | Online         | -                     | -        | -                   | 3                 | 50        | 50        | 100         | 3       |
| 2            | 25CSPC602   | Human Computer Interaction | Professional Core Course | Online         | -                     | -        | -                   | 3                 | 50        | 50        | 100         | 3       |
| 3            | 25CSSE603   | Industry Internship        | Skill Enhancement        |                | One semester duration |          |                     | 3                 | 100       | 100       | 200         | 12      |
| Total        |             |                            |                          |                |                       |          |                     | 9                 | 200       | 200       | 400         | 18      |

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| IV Semester |             |                                                                      |                          |                |                     |          |                     |                   |           |           |             |         |
|-------------|-------------|----------------------------------------------------------------------|--------------------------|----------------|---------------------|----------|---------------------|-------------------|-----------|-----------|-------------|---------|
| Sl.No       | Course Code | Course Title                                                         | Category                 | Teaching Dept. | Teaching Hours/Week |          |                     | Examinations      |           |           |             | Credits |
|             |             |                                                                      |                          |                | Theory Lecture      | Tutorial | Practical Component | Duration in hours | CIE Marks | SEE Marks | Total Marks |         |
| 1           | 25CSPC611   | Business Intelligence & Analytics                                    | Professional Core Course | Online         | -                   | -        | -                   | 3                 | 50        | 50        | 100         | 3       |
| 2           | 25CSPC612   | Reinforcement Learning                                               | Professional Core Course | Online         | -                   | -        | -                   | 3                 | 50        | 50        | 100         | 3       |
| 3           | 25CSSE613   | Project work                                                         | Skill Enhancement        | -              | -                   | -        | -                   | 3                 | 100       | 100       | 200         | 12      |
| 4           | 25CSSE614   | Publication of the Project findings / Patent Filing Project findings | Skill Enhancement        | -              | -                   | -        | -                   | -                 | 100       | -         | 100         | 3       |
| Total       |             |                                                                      |                          |                |                     |          |                     | 9                 | 300       | 200       | 500         | 21      |

| Advanced Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |           |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|---------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | I          | CIE Marks | 50            |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 25CSPC501  | SEE Marks | 50            |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3:0:2      | Exam Hrs  | 3             |
| Total Hrs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 64 (40+24) | Credits   | 4             |
| <b>Course Learning Objectives:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |           |               |
| <ol style="list-style-type: none"> <li>1. Describe sequence of different types of data structure operations and their cost finding techniques.</li> <li>2. Demonstrate various advanced data structures such as B-tree, Binomial heaps, Fibonacci heaps and Utilize disjoint sets and van Emde Roas Tree</li> <li>3. Impart knowledge on shortest paths for all pairs of vertices and from single source to all other vertices</li> <li>4. Describe the concept of maximum flow networks and to design and analyze MultiThreading algorithms.</li> <li>5. Provide knowledge on string matching algorithms to solve real-time problems</li> </ol> |            |           |               |
| <b>Module</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |           | No. of Hrs: 8 |
| Amortized Analysis: Aggregate analysis, The Aggregate analysis, The accounting method, The potential method, Dynamic Tables. B-Trees: Basic operations on B-Trees, Deleting a key from a B-Tree.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |           |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |           | No. of Hrs: 8 |
| Binomial trees and Binomial heaps: Operations on Binomial heaps. Structure of Fibonacci heaps, Mergeable heap operations, Decreasing a key and deleting a node. The van Emde Boas Tree: Preliminary approaches, A recursive structure, Disjoint-set operations: Linked-list representation of disjoint sets, Disjoint set forests.                                                                                                                                                                                                                                                                                                               |            |           |               |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |           | No. of Hrs: 8 |
| Single-Source Shortest Path: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Difference constraints and shortest paths. All-Pairs Shortest Paths: shortest Paths and matrix multiplication, Johnson's algorithm for sparse graphs.                                                                                                                                                                                                                                                                                                                                                                          |            |           |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |           | No. of Hrs: 8 |
| Maximum Flow: Flow Networks, The Ford-Fulkerson method, Maximum Bipartite Matching. Multithreaded Algorithms: The basics of dynamic multithreading, Multithreaded matrix multiplication, Multithreaded merge sort. SDL: Probabilistic analysis and randomized algorithms, linear programming and Approximation algorithm                                                                                                                                                                                                                                                                                                                         |            |           |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |           | No. of Hrs: 8 |
| The naive string-matching algorithm ,The Rabin-Karp algorithm ,String matching with finite automata ,The Knuth-Morris-Pratt algorithm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |           |               |

| Lab Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No. of Hrs: 24 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <ol style="list-style-type: none"> <li>1. Implement and analyze different approaches of Amortized Analysis by simulating a sequence of operations and comparing the results using Aggregate, Accounting, and Potential methods.</li> <li>2. Implement operations on B-Trees, including insertion, searching, and deletion of keys, and observe how the tree structure changes.</li> <li>3. Implement Binomial Heap operations such as creation of heap, insertion, finding minimum, merging heaps, and deletion of elements.</li> <li>4. Implement Fibonacci Heap operations including insert, extract-min, decrease-key, and delete, and analyze their performance.</li> <li>5. Implement the van Emde Boas Tree structure to perform operations such as insert, delete, and membership queries.</li> <li>6. Implement Disjoint Set data structures using linked-list representation and forest representation and perform union and find operations.</li> <li>7. Implement algorithms for Single Source Shortest Path problems and analyze their performance on different types of graphs.</li> <li>8. Implement algorithms for All-Pairs Shortest Path problems and compare their efficiency for dense and sparse graphs.</li> <li>9. Implement and analyze Maximum Flow algorithms for flow networks and apply them to a bipartite matching problem.</li> <li>10. Implement different String Matching algorithms and compare their efficiency for pattern searching in large text datasets.</li> </ol> |                |
| <p><b>Course Outcomes:</b><br/>At the end of the course, the student will be able to:</p> <p>CO1: Make use of sequence of different types of data structure operations and their cost finding techniques</p> <p>CO2: Demonstrate various advanced data structures such as B-tree, Binomial heaps, Fibonacci heaps and Utilize disjoint sets and van Emde Roas Tree.</p> <p>CO3: Discover shortest paths for all pairs of vertices and from single source to all other vertices.</p> <p>CO4 : Understand the concept of maximum flow networks and to design Multithreading algorithms.</p> <p>CO5: Apply string matching algorithms to solve real time problems</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |
| <p><b>TEXT BOOKS</b></p> <ol style="list-style-type: none"> <li>1. T. H Cormen, C E Leiserson, R L Rivest and C Stein ,(2010), <i>Introduction to Algorithm</i>, (3<sup>rd</sup> Edition), PHI</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| <p><b>REFERENCE BOOKS</b></p> <ol style="list-style-type: none"> <li>1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan, <i>Fundamentals of Computer Algorithm</i> (2<sup>nd</sup> Edition), Universities press,2007.</li> <li>2. Kenneth A. Berman. (2002) <i>Algorithms</i>. Cengage Learning,2002.</li> <li>3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms,” (3e), Pearson Education, 2011</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |

| Data Analytics using Python                                                                                                                                                                                                                                                                                                                                                                          |            |                       |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------|----|
| Semester                                                                                                                                                                                                                                                                                                                                                                                             | I          | CIE Marks             | 50 |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                          | 25CSPC502  | SEE Marks             | 50 |
| Teaching Hours/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                          | 3:0:2      | Exam Hrs              | 3  |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                          | 64 (40+24) | Credits               | 4  |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                                                                                                                                        |            |                       |    |
| 1. Describe IPython as an interactive computing environment and leverage NumPy for advanced data processing.                                                                                                                                                                                                                                                                                         |            |                       |    |
| 2. Impart knowledge on pandas for data manipulation, statistical analysis, and handling complex datasets efficiently                                                                                                                                                                                                                                                                                 |            |                       |    |
| 3. Describe the techniques for reading, writing, and interacting with diverse data formats, including text, JSON, XML, HTML, Excel, and databases, to enable efficient data extraction and storage workflows                                                                                                                                                                                         |            |                       |    |
| 4. Provide knowledge on data manipulation, transformation, and visualization techniques for effective data analysis                                                                                                                                                                                                                                                                                  |            |                       |    |
| 5. Impart knowledge on group-based operations, aggregations, and time series analysis using pandas                                                                                                                                                                                                                                                                                                   |            |                       |    |
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                      |            | No. of Hrs: 8         |    |
| IPython: An Interactive Computing and Development Environment: Using the Command History, Interacting with the Operating System, Software Development Tools<br>NumPy Basics: Arrays and Vectorized Computation: The NumPy ndarray: A Multidimensional Array Object, Data Processing Using Arrays, File Input and Output with Arrays, Linear Algebra                                                  |            |                       |    |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                      |            | No. of Hrs: 8         |    |
| <b>Getting Started with pandas:</b> Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics , Correlation and Covariance , Handling Missing Data, Hierarchical Indexing, Other pandas Topics.                                                                                                                                              |            |                       |    |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                      |            | No. of Hrs: 8         |    |
| <b>Data Loading, Storage, and File Formats:</b> Reading and Writing Data in Text Format, Reading Text Files in Pieces, Reading Text Files in Pieces, Manually Working with Delimited Formats<br><b>JSON Data, XML and HTML:</b> Web Scraping, Binary Data Formats, Reading Microsoft Excel Files, Interacting with HTML and Web APIs, Interacting with Databases, Storing and Loading Data in MngoDB |            |                       |    |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                      |            | No. of Hrs: 8         |    |
| Data Wrangling: Clean, Transform, Merge, Reshape: Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, Discretization and Binning, Detecting and Filtering Outliers, String Manipulation. Plotting and Visualization: A Brief matplotlib API Primer, Plotting Functions in pandas, Python Visualization Tool Ecosystem                                                      |            |                       |    |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                      |            | <b>No. of Hrs: 12</b> |    |
| Data Aggregation and Group Operations: Group By Mechanics, Data Aggregation, Group-wise Operations and Transformations, Pivot Tables and Cross-Tabulation. Time Series: Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Shifting                                                                                                                               |            |                       |    |

## Lab Components:

No. of Hrs:24

1. Write a program to calculate the mean, median, and standard deviation of a set of numbers using NumPy arrays and functions
2. Write a program to perform matrix multiplication using NumPy arrays.
3. Write a program to read data from a CSV file and display the first few rows using pandas.
4. Write a program to filter and manipulate data in a pandas DataFrame.
5. Write a program to analyze a dataset by calculating statistics and creating visualizations.
6. Write a program to perform data aggregation and grouping on a DataFrame.,
7. Write a program to load data from a CSV file, perform data analysis, and generate visualizations.
8. Write a program to save data to a JSON file and then load it back into a Python data structure.
9. Write a program to load data from an Excel file, perform data transformation, and save the results to a new Excel file.
10. Write a program to clean and preprocess a dataset by handling missing values and duplicates.
11. Write a program to merge and reshape multiple datasets using Pandas.
12. Write a program to visualize data using different graphical representations such as line plots, bar charts, scatter plots, and pie charts to understand and analyze the given dataset.
13. Write a program to perform more advanced data aggregation with Pandas
14. Write a program to perform pivot table aggregation in Pandas
15. Write a program to illustrate different basic operations in Date and Time

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

- CO1: Apply IPython features and NumPy tools to efficiently process and analyze multidimensional data
- CO2: Utilize pandas for manipulating and analyzing large datasets, performing statistical operations, and managing missing data
- CO3: Develop methods for reading, writing, and interacting with various data formats such as JSON, XML, and Excel to streamline data workflows
- CO4: Apply data transformation and visualization techniques using pandas and matplotlib to interpret and present data insights effectively
- CO5: Make use of group-based data aggregations, pivot tables, and time series analyses to derive meaningful patterns and trends in datasets

## TEXT BOOKS

1. Wes McKinney, Python for Data Analysis, (2<sup>nd</sup> Edition), O'Reilly Media, Inc. 2017

## REFERENCE BOOKS

1. Jake VanderPlas, *Python Data Science Handbook*, (2nd Edition) , O'Reilly Media, Inc.
2. Andreas C. Müller and Sarah Guido, (2016), *Introduction to Machine Learning with Python*, O'Reilly Media, Inc.
3. Field Cady, (2017), *The Data Science Handbook*, (1<sup>st</sup> Edition), Wiley.
4. Roger D. Peng and Elizabeth Matsui, (2016), *The Art of Data Science*

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| <b>Advances in Computer Networks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|----------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | I         | CIE Marks | 50             |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 25CSPC503 | SEE Marks | 50             |
| Teaching Hrs/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3:0:0     | Exam Hrs  | 3              |
| Total Hrs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 42        | Credits   | 3              |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"> <li>1. Describe network design principles, protocol layering, and reliable transmission techniques for efficient connectivity</li> <li>2. Impart knowledge on switching, routing, IP, addressing, and virtual networks</li> <li>3. Provide knowledge on routing protocols, global internet architecture, IPv6, and mobile IP concepts</li> <li>4. Describe UDP/TCP protocols, reliability, congestion control, and queuing mechanisms effectively</li> <li>5. Impart knowledge on congestion avoidance, DNS, email protocols, HTTP, and network management</li> </ol> |           |           |                |
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs: 08 |
| Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels.                                                                                                                                                                                                                                                                                     |           |           |                |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs: 09 |
| Internetworking I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internet work? Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.                                                                                                                                                                                                                                                                        |           |           |                |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs: 09 |
| Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |                |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs: 08 |
| End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery                                                                                                                                                                                                                                     |           |           |                |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs: 08 |
| Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME), World Wide Web (HTTP), Network Management (SNMP)                                                                                                                                                                                                                                                                                                                                                                                          |           |           |                |

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

- CO1: Demonstrate the principles of network design, protocol layering, and reliable transmission techniques to achieve efficient connectivity in modern communication networks
- CO2: Apply knowledge of switching, routing mechanisms, IP addressing schemes, and virtual networks to design interconnected systems
- CO3: Explain routing protocols, global internet architecture, IPv6, and mobile IP concepts for seamless and scalable networking solutions
- CO4: Plan the optimize data communication using UDP/TCP protocols, focusing on reliability, congestion control, and queuing mechanisms.
- CO5: Illustrate the working of congestion avoidance techniques, DNS, email protocols, HTTP, and network management strategies for maintaining efficient and robust network operations.

### TEXT BOOKS

1. Larry Peterson and Bruce S Davis , Computer Networks: A System Approach, (5<sup>th</sup> Edition) Elsevier, 2014
2. Douglas E Comer, (2014), Internet working with TCP/IP, Principles, Protocols and Architecture, 6th Edition, PHI.

### REFERENCE BOOKS

1. Uyles Black, Computer Networks, Protocols, Standards and Interfaces, (2<sup>nd</sup> Edition), PHI
2. Behrouz A Forouzan, TCP /IP Protocol Suite, (4<sup>th</sup> Edition), Tata McGraw-Hill.

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| <b>Object Oriented Software Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |           |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|----------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | I         | CIE Marks | 50             |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 25CSPC504 | SEE Marks | 50             |
| Teaching Hrs/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3:0:0     | Exam Hrs  | 3              |
| Total Hrs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 42        | Credits   | 3              |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"> <li>1. Describe software engineering fundamentals, methodologies, processes, and development models with their applicability</li> <li>2. Impart knowledge on object-oriented principles, analysis, design, and programming to develop effective software systems</li> <li>3. Provide knowledge on testing strategies for object-oriented analysis, design from class-level</li> <li>4. Describe technical metrics to evaluate object-oriented design, testing, and projects.</li> <li>5. Explore CASE tools, environments, and integration architectures for effective software development.</li> </ol> |           |           |                |
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           | No. of Hrs: 08 |
| Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges. Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models- Process, use, applicability and Advantages/limitations.                                                                                                                                                                                                                                                                                                                            |           |           |                |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           | No. of Hrs: 09 |
| Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object-oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model, OOA Process, Object Relationship model, Object Behavior Model, Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming                                                                                         |           |           |                |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           | No. of Hrs: 08 |
| Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           |                |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           | No. of Hrs: 09 |
| Technical Metrics for Object Oriented distinguishing Characteristics, Metrics Systems: The Intent of Object-Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation-Oriented Metrics, Metrics for Object Oriented testing, Metrics for Object Oriented projects                                                                                                                                                                                                                                                                                                                                                                         |           |           |                |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           | No. of Hrs: 08 |
| Computer-Aided Software Engineering: What is CASE?, Building blocks for CASE, A taxonomy of CASE tools, Integrated CASE environments, The Integration Architecture, The CASE Repository                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |           |                |

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

- CO1: Demonstrate understanding of software engineering principles, methodologies, and processes, and evaluate development models for various software applications.
- CO2: Apply object-oriented concepts, analysis, and design techniques to develop robust and efficient software systems.
- CO3: Design and implement effective testing strategies for object-oriented software systems, focusing on analysis, design, and class-level testing.
- CO4: Utilize technical metrics to assess the quality and performance of object-oriented designs, testing processes, and software projects.
- CO5: Integrate and utilize CASE tools, repositories, and environments to enhance software engineering productivity and maintainability.

### TEXT BOOKS

1. Object Oriented and Classical Software Engineering, 7/e, Stephen R. Schach, TMH.
2. Object oriented and Classical Software Engineering, Timothy Lethbridge, Robert Laganier, TMH
3. Software Engineering by Roger S Pressman, Tata McGraw Hill.

### REFERENCE BOOKS

1. Component based Software Engineering: ivic Crnkovic, Springer

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| <b>Research Methodology &amp; Technical Writing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|----------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | I         | CIE Marks | 50             |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 25CSPC505 | SEE Marks | 50             |
| Teaching Hrs/Week (L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1:0:2     | Exam Hrs  | 2.5            |
| Total Hrs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 37        | Credits   | 2              |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"> <li>1. Demonstrate foundational research principles and methodologies to conduct structured investigations</li> <li>2. Demonstrate critical and creative reading, research, and analytical skills to synthesize knowledge effectively</li> <li>3. Impart knowledge on how to Formulate and design research problems using appropriate techniques, methodologies, and theoretical principles</li> <li>4. Impart knowledge on effective writing strategies, language skills, and ethical guidelines for producing and publishing research outputs</li> </ol> |           |           |                |
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           | No. of Hrs: 02 |
| Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process.                                                                                                                                                                                                                                                                                                                                                                                   |           |           |                |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           | No. of Hrs: 03 |
| Criteria of Good Research , New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Effective Search: The Way Forward, Introduction to Technical Reading, Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet                                                                                                                                                                                                                                                                                                                    |           |           |                |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           | No. of Hrs: 02 |
| Introduction to Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Meaning of Research Design, Need for Research Design, features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs                                                                                                                                                                                                                                                                                                                 |           |           |                |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           | No. of Hrs: 02 |
| Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |           |                |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           | No. of Hrs: 03 |
| Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Writing Strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Publish Articles to Get Cited, or Perish, IMRaD Guidelines, COPE Guidelines                                                                                                                                                                                                                                                                                                                                                          |           |           |                |
| Practical Component:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs:26  |
| Writing a technical article                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           |                |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to:<br>CO1: Explain the basic research principles and methodologies<br>CO2: Describe critical and creative reading, research, and analytical skills for synthesizing knowledge<br>CO3: Design effective research problems using appropriate methodologies and principles<br>CO4: Apply writing strategies, language skills, and ethical guidelines for research publication                                                                                                                                                                                                      |           |           |                |

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### **Textbooks:**

1. C.R Kothari “Research Methodology Methods and Techniques” 2<sup>nd</sup> Edition, Newage international, 2009
2. Dipankar Deb, Rajeeb Dey, Valentina E. Balas, “Engineering Research Methodology A Practical Insightfor Researchers”, 1<sup>st</sup> Edition, Springer Nature, 2019

### **REFERENCE BOOKS**

1. David V. Thiel, “Research Methods for Engineers”, 1<sup>st</sup> Edition, Cambridge University Press, 2014
2. William G. Zikmund, Barry J. Babin, Jon C Carr, Mitch Griffin, “Business Research Methods”, 9<sup>th</sup> Edition, Cengage India Private Limited, 2013

### **Web links:**

1. Research Methodology Course: [https://onlinecourses.nptel.ac.in/noc24\\_ge41/preview](https://onlinecourses.nptel.ac.in/noc24_ge41/preview)
2. Module 4,5: <https://www.ipindia.gov.in/>
3. Module 4,5: <https://www.wipo.int/>
4. Reference Management tool: [https://desktop.download.mendeley.com/download/Getting\\_Started\\_Guide.pdf](https://desktop.download.mendeley.com/download/Getting_Started_Guide.pdf)
5. IMRad Guidelines: <https://writingcenter.gmu.edu/writing-resources/imrad/writing-an-imrad-report>
6. COPE Guidelines: <https://publicationethics.org/files/u7141/1999pdf13.pdf>

| Big Data Analytics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |           |              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | II         | CIE Marks | 50           |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 25CSPC511  | SEE Marks | 50           |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3:0:2      | Exam Hrs  | 3            |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 64 (40+24) | Credits   | 4            |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"> <li>1. Provide knowledge on Hadoop frame work and Hadoop Distributed File system</li> <li>2. Impart knowledge on HDFS and MapReduce concepts</li> <li>3. Provide knowledge on MapReduce programming model to process the big data</li> <li>4. Provide knowledge on working of pig and SPARK tool</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |           |              |
| Module1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |           | No.of Hrs:09 |
| <b>Meet Hadoop:</b> Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing<br><b>Hadoop Fundamentals</b> MapReduce: A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming The Hadoop Distributed File system The Design of HDFS, HDFS Concepts: Blocks,Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the Filesystem, Deleting Data, DataFlow: Anatomy of a File Read, Anatomy of a File Write.                                                                                                                 |            |           |              |
| Module2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |           | No.of Hrs:08 |
| <b>YARN Anatomy of a YARN Application Run:</b> Resource Requests, Application Life span, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness. Hadoop I/O Data Integrity, Data Integrity in HDFS, Local File System ,Checksum File System, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: Sequence File                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |           |              |
| Module3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |           | No.of Hrs:09 |
| <b>Developing a MapReduce Application</b> The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MR Unit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, Job Control, Apache Oozie How MapReduce Works Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers. |            |           |              |

| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | No. of Hrs:08 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------|
| <b>MapReduce Types and Formats:</b> MapReduce Types, Input Formats: Input Splits and Records, Text Input, Binary Input ,Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output, Flume Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |               |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | No. of Hrs:08 |
| <b>Pig</b> Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. <b>Spark</b> An Example: Spark Applications ,Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Sparkon YARN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |               |
| <b>Lab Component</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | <b>24 hrs</b> |
| <ol style="list-style-type: none"> <li>Implement the following file management tasks in Hadoop:               <ol style="list-style-type: none"> <li>Adding files and directories</li> <li>Retrieving files</li> <li>Deleting files</li> </ol>               Hint: A typical Hadoop workflow creates data files (such as log files)where and copies the minto HDFS using one of the above command line utilities             </li> <li>Run a basic word count MapReduce program to understand MapReduce Paradigm.</li> <li>Write a MapReduce program that mines weather data. Hint: Weather sensors collecting data every hour at any locations across the globe gather a large volume of log data,which is a good candidate for analysis with MapReduce, since it is semi Structured and record-oriented.</li> <li>Implement matrix multiplication with Hadoop MapReduce</li> <li>Run the Pig Latin Scripts to find Word Count.</li> <li>Write Pig Latin scripts to sort, group, join, project, and filter the data.</li> <li>Use Hive to create, alter, and drop databases, tables, views, functions, and indexes</li> <li>Run the Pig Latin Scripts to find a max temp for each and every year.</li> <li>Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.</li> </ol> |  |               |

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

1. Interpret managing big data using Hadoop and SPARK technologies
2. Explain HDFS and MapReduce concepts
3. Install, configure, and run Hadoop and HDFS
4. Perform map-reduce analytics using Hadoop and related tools
5. Explain SPARK concepts

## TEXTBOOKS

1. Tom White,(2012) Hadoop: The Definitive Guide,(3<sup>rd</sup>Edition),O'Reilley.
2. Eric Sammer (2012) Hadoop Operations,O'Reilley,.

## REFERENCEBOOKS

1. Vignesh Prajapati,(2013),Big data analytics with R and Hadoop,,SPD.
2. E.Capriolo, D.Wampler, and J.Rutherglen (2012) Programming Hive,,O'Reilley.
3. Lars George,(2011),HBase:The Definitive Guide,,O'Reilley.
4. Alan Gates,(2011),Programming Pig, O'Reilley.

| Artificial Intelligence and Machine Learning                                                                                                                                                                                                                                                                                                                                                                                                          |            |           |             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                              | II         | CIE Marks | 50          |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                           | 25CSPC512  | SEE Marks | 50          |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                            | 3:0:2      | Exam Hrs  | 3           |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                           | 64 (40+24) | Credits   | 4           |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                                                                                                                                                                                         |            |           |             |
| 1. Impart knowledge on fundamental concepts of Artificial Intelligence and Problem Solving.                                                                                                                                                                                                                                                                                                                                                           |            |           |             |
| 2. Provide knowledge on advanced problem-solving paradigms and knowledge representation.                                                                                                                                                                                                                                                                                                                                                              |            |           |             |
| 3. Impart knowledge on Machine Learning algorithms.                                                                                                                                                                                                                                                                                                                                                                                                   |            |           |             |
| 4. Impart knowledge on Neural Network, building neural networks to solve various classifications.                                                                                                                                                                                                                                                                                                                                                     |            |           |             |
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |           | No.ofHrs:08 |
| Introduction, Problem Solving: state space search and control strategies: Introduction, General problem solving, Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative Deepening, Constant satisfaction.                                                                                                                                                                                                            |            |           |             |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |           | No.ofHrs:08 |
| Problem reduction and Game playing, Logic concepts and logic programming: Introduction, Problem reduction, Game playing, Bounded look ahead strategy and Use of, Alpha-Beta Pruning, Two –player perfect information games. Propositional calculus, Propositional logic, Natural Deduction system, Axiomatic system, Semantic tableau system in propositional logic, resolution refutation in propositional logic, Predicate logic, Logic programming |            |           |             |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |           | No.ofHrs:08 |
| Advanced problem-solving paradigm: planning- types of planning systems, Block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis, Non –linear planning strategies. Knowledge representation: Approaches to knowledge representation, knowledge representation using semantic network, Extended semantic networks for KR, Knowledge representation using frames                                              |            |           |             |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |           | No.ofHrs:08 |
| Uncertainty Measure: Probability Theory, Bayesian Belief Networks, Machine Learning Paradigms: Machine learning system, supervised and unsupervised learning, Inductive, deductive learning, Clustering.                                                                                                                                                                                                                                              |            |           |             |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |           | No.ofHrs:08 |
| Support vector Machine, case-based reasoning and learning. ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network                                                                                                                                                                                                                                                                                                                |            |           |             |

| Lab Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | No. of Hrs:24 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <ol style="list-style-type: none"> <li>1. Implement and Demonstrate DFS Algorithm on water Jug Problem.</li> <li>2. Implement and Demonstrate BFS Algorithm on any AI problem.</li> <li>3. Implement of TSP using heuristic approach.</li> <li>4. Implement any game and demonstrate the Game playing strategies.</li> <li>5. 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.</li> <li>6. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.</li> <li>7. Write a program to implement feature reduction using Principle Component Analysis</li> <li>8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.</li> <li>9. Write a program to implement perceptron for different learning task.</li> <li>10. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets..</li> </ol> |               |
| <p><b>Course Outcomes:</b> At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Apply state space search and heuristic strategies to solve general AI problem-solving tasks.</li> <li>2. Implement logic-based reasoning using propositional and predicate logic in knowledge-based systems.</li> <li>3. Apply planning techniques and knowledge representation methods to design intelligent agent systems.</li> <li>4. Apply machine learning paradigms and neural networks to solve classification or clustering problems</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |
| <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Artificial Intelligence, Saroj Kaushik Cengage Learning 2014 Edition.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |
| <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F Luger Pearson Addison Wesley 6 th Ed, 2008.</li> <li>2. Artificial Intelligence, E Rich, K Knight, and S B Nair Tata Mc-Graw Hill 3rd Ed, 2009.</li> <li>3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig Prentice Hall 3rd, 2009.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |

# MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

| Blockchain Technology                                                                                                                                                                                                                                                                 |           |           |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|---------------|
| Semester                                                                                                                                                                                                                                                                              | II        | CIE Marks | 50            |
| Course Code                                                                                                                                                                                                                                                                           | 25CSPC513 | SEE Marks | 50            |
| Teaching Hrs/Week(L:T:P)                                                                                                                                                                                                                                                              | 4:0:0     | Exam Hrs  | 3             |
| Total Hrs                                                                                                                                                                                                                                                                             | 52        | Credits   | 4             |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                         |           |           |               |
| 1. Provide knowledge on fundamentals of blockchain technology, its history, types, and relevance to distributed systems and the CAP theorem.                                                                                                                                          |           |           |               |
| 2. Provide knowledge on the concepts of decentralization and apply cryptographic principles including asymmetric encryption and key management.                                                                                                                                       |           |           |               |
| 3. Impart knowledge on Bitcoin architecture, transaction flow, and compare with various alternative cryptocurrencies and their underlying limitations.                                                                                                                                |           |           |               |
| 4. Impart knowledge on smart contracts and the Ethereum blockchain, including its components and the use of precompiled contracts.                                                                                                                                                    |           |           |               |
| 5. Provide knowledge on the application of blockchain technology beyond cryptocurrencies in IoT, governance, healthcare, finance, and media sectors.                                                                                                                                  |           |           |               |
| <b>Module 1</b>                                                                                                                                                                                                                                                                       |           |           | No. of Hrs:10 |
| <b>Blockchain 101:</b> Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.                                                                                               |           |           |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                       |           |           | No. of Hrs:11 |
| <b>Decentralization and Cryptography:</b> Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private Keys |           |           |               |
| <b>Module 3</b>                                                                                                                                                                                                                                                                       |           |           | No. of Hrs:11 |
| <b>Bitcoin and Alternative Coins:</b> Bitcoin, Transactions, Blockchain, Bitcoin payments. Alternative Coins, Theoretical foundations, Bit coin limitations, Namecoin, Litecoin, Primecoin, Zcash                                                                                     |           |           |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                       |           |           | No. of Hrs:10 |
| <b>Smart Contracts and Ethereum 101:</b> Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum – bird's eye view, Components of the Ethereum ecosystem                                                                                               |           |           |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                       |           |           | No. of Hrs:10 |
| <b>Alternative Blockchains:</b> Blockchains <b>Blockchain-Outside of Currencies:</b> Internet of Things, Government, Health, Finance, Media                                                                                                                                           |           |           |               |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to:                                                                                                                                                                                                        |           |           |               |
| 1. Describe blockchain basics, types, CAP theorem, and its role in distributed systems.                                                                                                                                                                                               |           |           |               |
| 2. Analyze the cryptographic methods and decentralization principles using public and private key mechanisms.                                                                                                                                                                         |           |           |               |
| 3. Describe Bitcoin transactions and compare alternative cryptocurrencies based on their features and limitations.                                                                                                                                                                    |           |           |               |
| 4. Interpret the concept of smart contract concepts and examine Ethereum blockchain architecture and its key components.                                                                                                                                                              |           |           |               |
| 5. Apply blockchain concepts to real-world sectors like IoT, healthcare, finance, and government systems.                                                                                                                                                                             |           |           |               |
| <b>Text Books</b>                                                                                                                                                                                                                                                                     |           |           |               |
| 1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017                                                                                              |           |           |               |

**Reference Books**

1. Daniel Drescher, A press, (2017), *Blockchain Basics: A Non-Technical Introduction in 25Steps*, (1<sup>st</sup>Edition) , 2017
2. Andreas M. Antonopoulos, (2014), *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*, (1<sup>st</sup> Edition), O'Reilly Media.

| Advances in Digital Image Processing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |           |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|---------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | II        | CIE Marks | 50            |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 25CSPE521 | SEE Marks | 50            |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4:0:0     | Exam Hrs  | 3             |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 52        | Credits   | 4             |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"> <li>1. Impart Knowledge on fundamentals of digital image</li> <li>2. Provide knowledge on simple image enhancement techniques in Spatial and Frequency domain.</li> <li>3. Provide knowledge on concepts of degradation function and restoration techniques.</li> <li>4. Provide knowledge on image segmentation and representation techniques.</li> <li>5. Impart knowledge on image compression and recognition methods</li> </ol> |           |           |               |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs:10 |
| <b>Digital Image Fundamentals:</b> Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization– Relationships between pixels – Color image fundamentals - RGB, HIS models, Two-dimensional mathematical preliminaries, 2D transforms-DFT, DCT.                                                                                                                                                                                                   |           |           |               |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs:11 |
| <b>Image Enhancement:</b> Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform–Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.                                                                                                                                                                |           |           |               |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs:10 |
| <b>Image Restoration:</b> Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band passFilters–NotchFilters–OptimumNotchFiltering–InverseFiltering–Wiener Filtering                                                                                                                                                                                                                                                                          |           |           |               |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. of Hrs:10 |
| <b>Image Segmentation:</b> Edge detection, Edge linking via Hough transform–Thresholding- Region based segmentation –Region growing–Region splitting and merging–Morphological processing-erosionanddilation,Segmentationbymorphologicalwatersheds–basicconcepts–Dam Construction – Watershed segmentation algorithm.                                                                                                                                                                                                                 |           |           |               |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           | No. ofHrs:11  |
| <b>Image Compression And Recognition:</b> Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors–Topological feature, Texture-Patterns and Pattern classes-Recognition based on matching.                                                                                                                                                                                              |           |           |               |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to: <ol style="list-style-type: none"> <li>1. Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.</li> <li>2. Operate on images using the techniques of smoothing, sharpening and enhancement.</li> <li>3. Interpret the basics of segmentation, features extraction, compression and recognition methods for color models.</li> </ol>                                       |           |           |               |
| <b>Text Books</b> <ol style="list-style-type: none"> <li>1. Rafael C. Gonzalez, Richard E. Woods,(2010), <i>Digital Image Processing</i>, (3<sup>rd</sup>Edition), Pearson.</li> <li>2. Anil K. Jain, (2002), <i>Fundamentals of Digital Image Processing</i>, Pearson.</li> </ol>                                                                                                                                                                                                                                                    |           |           |               |

## Reference Books

1. Kenneth R. Castleman,(2006), *Digital Image Processing*, Pearson.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,(2011), *Digital Image processing using MATLAB*, Pearson Education, Inc.
3. William K. Pratt, *Digital Image Processing*, (2002), John Wiley, Network.
4. Milan Sonkaetal, Brookes/Cole,(1999), *Image processing, analysis and machine vision*, (2<sup>nd</sup> Edition), Vikas Publishing House.

| Advances in Computer Architecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |               |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|----|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | II        | CIE Marks     | 50 |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 25CSPE522 | SEE Marks     | 50 |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4:0:0     | Exam Hrs      | 3  |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 52        | Credits       | 4  |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"><li>1. Impart knowledge on parallel computing using pipeline</li><li>2. Impart knowledge on memory hierarchy</li><li>3. Provide knowledge on scalable computing</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |               |    |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | No. of Hrs:11 |    |
| <b>Fundamentals Of Computer Design, Pipelining, ILP</b> Introduction; Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design. Introduction; Pipeline hazards; Implementation of pipeline; What makes pipelining hard to implement? Instruction –Level Parallelism – 1 ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Reducing Branch costs with prediction; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation. Instruction – Level Parallelism – 2 Exploiting ILP using multiple issue and static scheduling; Exploiting ILP using dynamic scheduling, multiple issue and speculation; Advanced Techniques for instruction Delivery and Speculation; The Intel Pentium4 as example. |           |               |    |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | No. of Hrs:10 |    |
| <b>Review of Memory Hierarchy, Memory Hierarchy design</b> Introduction; Cache performance; Cache Optimizations, Virtual memory, Introduction; Advanced optimizations of Cache performance; Memory technology and optimizations; Protection: Virtual memory and virtual machines.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |               |    |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | No. of Hrs:10 |    |
| <b>Theory of Parallelism</b> Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multi vector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or machine is many one example is sufficient.                                                                                                                                                                                                                                                                                                                                                                           |           |               |    |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | No. of Hrs:11 |    |
| <b>Hardware Technologies</b> Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. For all Algorithms or mechanisms any one example is sufficient. Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors. For all Algorithms or mechanisms any one example is sufficient                                                                                                                                                                                                                                                                                                                                                                           |           |               |    |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           | No. of Hrs:10 |    |
| <b>Parallel and Scalable Architectures:</b> Multiprocessors and Multi computers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Message Passing Mechanisms, Multi vector and SIMD Computers, Vector Processing Principles, Multivector                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |               |    |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to <ol style="list-style-type: none"><li>1. Apply the concepts of pipelining and instruction-level parallelism to evaluate processor performance and identify pipeline hazards.</li><li>2. Analyze and apply memory hierarchy design principles to improve system performance using cache optimization and virtual memory techniques.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |               |    |

3. Explain models of parallel computing and evaluate performance improvements using speedup laws and partitioning techniques.
4. Apply pipelining and superscalar techniques to enhance processor performance and assess memory organization strategies.
5. Describe the structure of scalable architectures and apply synchronization and message-passing mechanisms in multiprocessor systems.

## Text Book

1. John L. Hennessy and David A. Patterson, (2019), *Computer Architecture: A Quantitative Approach*, (6th Edition), Morgan Kaufmann Publishers.

## Reference Book

1. Kai Hwang, (1993), *Advanced Computer Architecture: Parallelism, Scalability, Programmability*, McGraw-Hill Education.
2. David A. Patterson and John L. Hennessy, (2020), *Computer Organization and Design: RISC-V Edition*, (5th Edition), Morgan Kaufmann Publishers.

| Advances in Wireless Sensor Networks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |               |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|----|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | II        | CIE Marks     | 50 |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 25CSPE523 | SEE Marks     | 50 |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4:0:0     | Exam Hrs      | 3  |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 52        | Credits       | 4  |
| <b>Course Learning Objectives:</b> This course is designed to <ol style="list-style-type: none"><li>1. Impart knowledge on fundamentals of wireless sensor networks and its application to critical real time scenarios.</li><li>2. Provide knowledge on various protocols at various layers and its differences with traditional protocols.</li><li>3. Impart knowledge on issues pertaining to sensor networks and the challenges involved in managing sensor network</li></ol>                                                                                                                                                            |           |               |    |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | No. of Hrs:10 |    |
| <b>Introduction:</b> Fundamentals of wireless communication technology, the electromagnetic spectrum Radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.                                                                                                                                                                                                                                                                                                                                                                     |           |               |    |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | No .of Hrs:11 |    |
| <b>Introduction to adhoc/sensor networks:</b> Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhocwirelessnetworks,issuesindesignofsensornetwork,sensornetworkarchitecture,data Dissemination and gathering.                                                                                                                                                                                                                                                                                                                             |           |               |    |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | No. of Hrs:10 |    |
| <b>MAC Protocols:</b> Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.                                                                                                                                                                                                                                                                                                                                                                                                       |           |               |    |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | No.of Hrs:10  |    |
| <b>Routing Protocols:</b> Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |               |    |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | No. of Hrs:11 |    |
| <b>QoS and Energy Management:</b> Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, Transmission power, and system power management schemes.                                                                                                                                                                                                                                                                                                                                                                                       |           |               |    |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to <ol style="list-style-type: none"><li>1. Explain fundamentals of wireless communication, ad hoc and sensor networks, MAC, routing, QoS, and energy management concepts.</li><li>2. Apply MAC protocol design principles and standards for efficient communication in wireless ad hoc and sensor networks.</li><li>3. Apply appropriate routing protocols for data transmission in wireless ad hoc and sensor network environments.</li><li>4. Apply QoS and energy management techniques to improve performance and efficiency in wireless networks.</li></ol> |           |               |    |
| <b>Text Books</b> <ol style="list-style-type: none"><li>1. C. Siva Ram Murthy, and B. S. Manoj,(2008), <i>AdHoc Wireless networks</i>, Pearson Education.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |               |    |

**Reference Books**

1. Feng Zhao and Leonides Guibas,(2004), *Wireless sensor networks*, Elsevier publication.
2. Jochen Schiller, (2003), *Mobile Communications*, (2<sup>nd</sup> Edition), Pearson Education.
3. William Stallings, (2004), *Wireless Communications and Networks*, Pearson Education.

| Cryptography and Network Security                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |           |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|---------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | II        | CIE Marks | 50            |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 25CSPE531 | SEE Marks | 50            |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4:0:0     | Exam Hrs  | 3             |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 52        | Credits   | 4             |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |           |               |
| 1. Impart knowledge on basics of Cryptography and Network Security.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |           |               |
| 2. Impart knowledge on securing a message over in secure channel by various means.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           |               |
| 3. Impart knowledge on how to maintain the Confidentiality, Integrity and Availability of a data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |           |               |
| 4. Impart knowledge on various protocols for network security to protect against the threats in the networks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |           |               |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           | No. of Hrs:11 |
| Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the Feistel Cipher structure, the Feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm                                                                                                                                                                                                                                                                                                                                                                                                                |           |           |               |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           | No. of Hrs:10 |
| Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffie Hellmankey Exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |           |               |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           | No. of Hrs:11 |
| Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509certificates. Certificates, X-509 version 3, public key infrastructure. User Authentication: Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication, federated identity management, identity management, identity federation, personal identity verification. |           |           |               |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           | No. of Hrs:11 |
| Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE802protocol architecture. Security, IEEE 802.11i services, IEEE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           |               |

802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase, the IEEE 802.11i pseudorandom function. Web Security Considerations: Web Security Threats, Web Traffic Security Approaches. Secure Sockets Layer: SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. Transport Layer Security: Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. HTTPS Connection Initiation, Connection Closure. Secure Shell(SSH) Transport Layer Protocol, User Authentication Protocol, Connection Protocol

**Module5**

No. of Hrs:10

Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. IP Security: IP Security overview, applications of IP sec, benefits of IP sec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Antire play service, transport and tunnel modes, combining security associations, authentication plus confidentiality, basic combinations of security associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits.

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

1. Apply classical and block cipher techniques to encrypt and secure data.
2. Apply public-key cryptographic algorithms for secure communication and key exchange.
3. Apply key management and authentication mechanisms to establish secure access.
4. Explain wireless and web security protocols used for secure communications.
5. Explain email and IP security mechanisms for protecting data transmission.

**Text Books**

1. *Cryptography and Network Security*, William Stallings, Pearson, 6<sup>th</sup> edition

**Reference Books**

1. *Cryptography and Information Security*, VK Pachghare. PHI, 2<sup>nd</sup> edition

# MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

| Compiler Optimization Techniques                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |           |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|---------------|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | II        | CIE Marks | 50            |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 25CSPE532 | SEE Marks | 50            |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4:0:0     | Exam Hrs  | 3             |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 52        | Credits   | 4             |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |           |               |
| 1. Provide knowledge on different forms of intermediate languages and analyzing programs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |           |               |
| 2. Provide knowledge on optimization techniques for single program blocks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |           |               |
| 3. Provide knowledge on optimizations on procedures and low level code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           |               |
| 4. Provide knowledge on enhancing resource utilization                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |           |               |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           | No. of Hrs:10 |
| Structure of an Optimizing Compiler – Compiler Construction tools - LIR, MIR, HIR – DAG – Syntax Tree – Postfix – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Basic Block Dependence DAGs – Alias Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |           |               |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           | No. of Hrs:10 |
| Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common-Subexpression Elimination- Loop-Invariant Code Motion- Partial-Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.                                                                                                                                                                                 |           |           |               |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           | No. of Hrs:11 |
| Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining. |           |           |               |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           | No. of Hrs:10 |
| Symbol table – Runtime Support – Inter procedural Analysis and Optimization: Inter procedural Control-Flow Analysis - The Call Graph – Inter procedural Data-Flow Analysis – Inter procedural Constant Propagation – Inter procedural Alias Analysis – Inter procedural Optimizations – Inter procedural Register Allocation - Aggregation of Global References                                                                                                                                                                                                                                                                                                                        |           |           |               |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           | No. of Hrs:11 |
| Register Allocation: Register Allocation and Assignment –Local Methods-Graph Coloring–Priority Based Graph Coloring -Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations                                                                                                                                                                                                                                                                                                |           |           |               |
| <b>Course Outcomes:</b> At the end of the course, the student will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           |               |
| 1. Identify the different optimization techniques that are possible for a sequence of code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |           |               |
| 2. Design performance enhancing optimization techniques                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |           |               |
| 3. Manage procedures with optimal overheads                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |           |               |
| 4. Ensure better utilization of resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |           |               |
| <b>Text Book</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |           |               |
| 1. Steven Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufman                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |           |               |

**Reference Books**

2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
3. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
4. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.
5. Randy Allen and Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufman, 2001.

| Pattern Recognition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |               |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|----|
| Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | II        | CIE Marks     | 50 |
| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 25CSPE533 | SEE Marks     | 50 |
| Teaching Hours/Week(L:T:P)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4:0:0     | Exam Hrs      | 3  |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 52        | Credits       | 4  |
| <b>Course Learning Objectives:</b> This course is designed to                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |               |    |
| <div>1. Impart knowledge on concepts of pattern recognition, probability theory, and statistical estimation methods.</div> <div>2. Impart knowledge on Analysing and represent datasets using feature extraction, feature selection, and proximity measures.</div> <div>3. Provide knowledge on classification techniques such as nearest neighbour, Naive Bayes, and decision trees.</div> <div>4. Provide knowledge on Evaluation of clustering algorithms and probabilistic models for pattern recognition applications.</div> |           |               |    |
| <b>Module1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | No. of Hrs:10 |    |
| Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems                                                                                                                                                                                                                                                                                        |           |               |    |
| <b>Module2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | No. of Hrs:10 |    |
| Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation                                                                                                                                                                                                                                                                                                                                              |           |               |    |
| <b>Module3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | No. of Hrs:11 |    |
| Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network                                                                                                                                      |           |               |    |
| <b>Module4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | No. of Hrs:11 |    |
| Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM                                                                                                                                                                                                                                                |           |               |    |
| <b>Module5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | No. of Hrs:10 |    |
| Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional Forgys, kmeans, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition                                                                                                                                                                                                                                                                                                                        |           |               |    |
| <b>Course Outcomes:</b> A the end of the course ,the student will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |               |    |
| <div>1. Explain fundamental concepts and techniques of pattern recognition and probabilistic models.</div> <div>2. Apply feature extraction, feature selection, and proximity measures for dataset representation.</div> <div>3. Apply classification techniques such as nearest neighbor, Naive Bayes, and decision trees.</div> <div>4. Apply clustering algorithms and probabilistic models for pattern recognition problems.</div>                                                                                            |           |               |    |
| <b>Text Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |               |    |
| 1. Pattern Recognition (An Introduction), V Susheela Devi, M Narsimha Murthy. Universities press, 2011.                                                                                                                                                                                                                                                                                                                                                                                                                           |           |               |    |

2. Pattern Recognition & Image Analysis, Earl Gose, Richard Johnson baugh, Steve Jost . PH, 1996.

**Reference Books**

1. Pattern Recognition and Machine Learning, **Bishop, Christopher M.** *Pattern Recognition and Machine Learning*. New York: Springer, 2006.
2. Pattern Classification, **Duda, Richard O., Peter E. Hart, and David G. Stork.** *Pattern Classification*, 2nd Edition. New York: Wiley, 2001