SANJIVANI RURAL EDUCATION SOCIETY'S

# SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

*(An Autonomous Institute affiliated to SPPU, Pune)*



## DEPARTMENT OF COMPUTER ENGINEERING



## COURSE STRUCTURE AND SYLLABUS- 2025 PATTERN (NEP 2020 w.e.f AY 2025-26)

### FIRST YEAR MTECH COMPUTER ENGINEERING

DECLARATION

We, the Board of Computer Engineering, hereby declare that we have designed the Curriculum and syllabus of **F.Y. M.Tech 2025 PATTERN Sem I** (NEP 2020 w.e.f AY 2025-26) as per the guidelines. Hence, we are pleased to submit and publish this Final Copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Approved by

Dean Academics                                                                    Director

# SRES'S SANJIVANI COLLEGE OF ENGINEERING KOPARGAON
## *(An Autonomous Institute Affiliated to SPPU Pune)*
### F.Y. M. TECH. COURSE STRUCTURE-2025 PATTERN
### *(as per NEP 2020)*
### FIRST YEAR M. TECH COMPUTER ENGINEERING (A.Y.2025-26)
## SEMESTER I

## CREDIT DISTRIBUTION

|  | SEM-I | SEM-II | SEM-III | SEM-IV | Total |
|---|---|---|---|---|---|
| PCC | 15 | 15 |  |  | 30 |
| PEC |  |  | 12 |  | 12 |
| OE |  |  |  | 4 | 4 |
| Human Rights | 1 | 1 |  |  | 2 |
| Skill Development |  |  | 2 | 2 | 4 |
| Cyber Security |  |  | 4 |  | 4 |
| RM | 4 |  |  |  | 4 |
| PRJ |  | 4 | 4 | 6 | 14 |
| Internship |  |  |  | 6 | 6 |
| Total | 20 | 20 | 22 | 18 | 80 |

| Category | Details |
|---|---|
| PC | Program Core Subject |
| VE | Value Education Course |
| RM | Research Methodology |
| PR | Project |
| PE | Program Elective |
| OE | Open Elective |
| CS | Cyber Security |
| SD | Skill Development Subject |
| AT | Advanced Technical Skill Subject |

# SRES'S SANJIVANI COLLEGE OF ENGINEERING KOPARGAON
## *(An Autonomous Institute Affiliated to SPPU Pune)*
### F.Y. M.TECH. COURSE STRUCTURE-2025 PATTERN
### *(as per NEP 2020)*
### FIRST YEAR M. TECH COMPUTER ENGINEERING (A.Y.2025-26)
### SEMESTER I

| Course | | Teaching Scheme Hours/Week | | | Credits | Evaluation Scheme - Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Titles | Classroom Instruction (CI) (Hrs/Week) | | Lab Instruction (LI) (Hrs/Week) | Credits | Theory | | OR | PR | TW | Total |
| | | L | T | P | | CIA | ESE | | | | |
| PCCO501 | Mathematical Foundations of Computer Science | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO502 | Advanced Data Structures | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO503 | Cloud Technology | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO504 | Lab Practice-I (Advanced Data Strucrures) | - | - | 4 | 2 | - | - | 50 | - | - | 50 |
| VECO505 | Human Rights | 1 | - | - | 1 | - | 50 | - | - | -- | 50 |
| RMCO506 | Research Methodology and IPR | 4 | - | - | 4 | 40 | 60 | - | - | - | 100 |
| PCCO507 | Data Analytics and Business Intelligence – NPTEL Course | 2 | - | - | 2 | - | 50 | - | - | -- | 50 |
| PCCO508 | Lab Practice-II (Cloud Technology) | - | - | 4 | 2 | - | - | 50 | - | - | 50 |
| Total | | 16 | 0 | 8 | 20 | 160 | 340 | 100 | 0 | -- | 600 |

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### *(as per NEP 2020)*
### FIRST YEAR M. TECH COMPUTER ENGINEERING (A.Y.2025-26)
### SEMESTER II

| Course | | Teaching Scheme Hours/Week | | | Credits | Evaluation Scheme - Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Titles | Classroom Instruction (CI) (Hrs/Week) | | Lab Instruction (LI) (Hrs/Week) | Credits | Theory | | OR | PR | TW | Total |
| | | L | T | P | | CIA | ESE | | | | |
| PCCO509 | Advance Algorithms | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO510 | Advance Network and Analysis | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO511 | Applied Cloud Technology | 3 | - | - | 3 | 40 | 60 | - | - | - | 100 |
| PCCO512 | Blockchain Technology-NPTEL Course | 2 | - | - | 2 | - | 50 | - | - | - | 50 |
| PCCO513 | Lab Practice-III (Advance Algorithms) | - | - | 4 | 2 | - | - | 50 | - | - | 50 |
| PCCO514 | Lab Practice-IV (Applied Cloud Technology) | - | - | 4 | 2 | - | - | 50 | - | - | 50 |
| VECO515 | Human Rights | 1 | - | - | 1 | - | - | 50 | - | - | 50 |
| PRCO516 | Mini Project | - | - | 8 | 4 | - | - | 50 | - | 50 | 100 |
| Total | | 12 | 0 | 16 | 20 | 120 | 230 | 200 | 0 | 50 | 600 |

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### *(as per NEP 2020)*
### SECOND YEAR M. TECH COMPUTER ENGINEERING (A.Y.2025-26)
### SEMESTER III

| Course | | Teaching Scheme Hours/Week | | Credits | Evaluation Scheme - Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Titles | Classroom Instruction (CI) (Hrs/Week) | Lab Instruction (LI) (Hrs/Week) | Credit | Theory | | OR | PR | TW | Total |
| | | L | T | P | | CIA | ESE | | | | |
| PECO601 | A-Machine Intelligence B- Wireless Networks and IOT C- Pattern Recognition | 4 | - | - | 4 | 40 | 60 | - | - | - | 100 |
| PECO602 | A- Parallel Computing B-Soft Computing C- Image and Video Processing | 4 | - | - | 4 | 40 | 60 | - | - | - | 100 |
| PECO603 | A- Geographic Information Systems B- Digital Forensics C- Software Design and Architecture | 4 | - | - | 4 | 40 | 60 | - | - | - | 100 |
| SDCO604 | A- Any course of 60 Hrs duration on skill development | - | - | 4 | 2 | - | 50 | - | - | - | 50 |
| CSCO605 | Cyber Security | 4 | - | - | 4 | - | 100 | - | - | - | 100 |
| PRCO606 | Dissertation Phase – I | - | - | 8 | 4 | - | - | 50 | - | 50 | 100 |
| **Total** | | **16** | **0** | **12** | **22** | **120** | **330** | **50** | **-** | **50** | **550** |

# SRES'S SANJIVANI COLLEGE OF ENGINEERING KOPARGAON
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## S.Y. M.TECH. COURSE STRUCTURE-2025 PATTERN
### *(as per NEP 2020)*
### SECOND YEAR M. TECH COMPUTER ENGINEERING (A.Y.2025-26)
### SEMESTER IV

| Course | | Teaching Scheme Hours/Week | | Credits | Evaluation Scheme - Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Titles | Classroom Instruction (CI) (Hrs/Week) | Lab Instruction (LI) (Hrs/Week) | Credit | Theory | | OR | PR | TW | Total |
| | | L | T | P | | CIA | ESE | | | | |
| OECO607 | A. Industrial Safety and Management B. Machine Learning C. Sartup and Venture Management D. Project Planning and Operation Research E. Composite Materials F. Recent Trends in Computer Technology | 4 | - | - | 4 | 40 | 60 | - | - | - | 100 |
| OECO608 | Industry Internship | - | - | 12 | 6 | - | - | 50 | - | 100 | 150 |
| ATCO609 | Advanced Technical Skills (MOOCs) | 2 | - | - | 2 | 20 | 30 | - | - | - | 50 |
| PRCO610 | Dissertation Phase – II | - | - | 6 | 6 | - | - | 100 | - | 50 | 150 |
| Total | | 6 | 0 | 18 | 18 | 60 | 90 | 150 | 0 | 150 | 450 |

## Vision

To develop world class engineering professionals with good moral characters and make them capable to exhibit leadership through their engineering ability, creative potential and effective soft skills which will improve the quality of life in society.

## Mission

To impart quality technical education to the students through innovative and interactive teaching and learning process to acquire sound technical knowledge, professional competence and to have aptitude for research and development.

Develop students as excellent communicators and highly effective team members and leaders with full appreciation of the importance of professional, ethical and social responsibilities.

## Program Educational Objectives (PEOs)

1. To prepares the committed and motivated graduates by developing technical competency, research attitude and life-long learning with support of strong academic environment.
2. Train graduates with strong fundamentals and domain knowledge, update with modern technology to analyse, design & create novel products to provide effective solutions for social benefits.
3. Exhibit employability skills, leadership and right attitude to succeed in their professional career.

## Program Outcomes (POs)

**Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs)

1. **Professional Skills:** The ability to apply knowledge of problem solving, algorithmic analysis, software Engineering, Data Structures, Networking, Database with modern recent trends to provide the effective solutions for Computer Engineering Problems.

2. **Problem-Solving Skills:** The ability to inculcate best practices of software and hardware design for delivering quality products useful for the society.

3. **Successful Career:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths.

# SEMESTER I

| PCCO501: Mathematical Foundation of Computer Science | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 3 Hrs./Week** | **CIA**                 : 40 Marks |
| **Tutorial:** | **End-Semester Exam:**    : 60 Marks |
| **Credits: 3** | **Total:**               : 100 Marks |
| **Prerequisite Course:**   Discrete Mathematics | |

**Course Objectives:**

1. To learn and understand the probability mass and density function.

2. To learn and understand the sampling distributions of estimators and methods of moments.

3. To study statistical inference and classification problems.

4. To learn and understand the graph theory, Permutations and Combinations.

5. To learn and understand mathematical and statistical techniques to emerging areas of Information Technology.

6. To learn and understand recent trends of various distribution functions in mathematical field of computer science.

**Course Outcomes (COs):**

After successful completion of the course, student will be able to

| Course Outcome (s) | | Bloom's Taxonomy | |
|---|---|---|---|
| | | **Level** | **Descriptor** |
| CO1 | **Solve** the problem using probability mass and density function | 3 | Apply |
| CO2 | **Demonstrate** sampling distributions of estimators and methods of moments. | 3 | Apply |
| CO3 | **Use** the methods of statistical inference, and the role that sampling distributions play in those methods. | 3 | Apply |
| CO4 | **Demonstrate** applications of graph theory and combinatorial problem. | 3 | Apply |
| CO5 | **Analyze** the applications of mathematical and statistical techniques to emerging areas of Information Technology | 4 | Analze |
| CO6 | **Demonstrate** recent trends of various distribution functions in mathematical field of computer science. | 3 | Apply |

| COURSE CONTENTS | | | |
|---|---|---|---|
| **Unit-I** | **PROBABILITY MASS, DENSITY** | **No. of Hours** | **COs** |
| | Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains | 08 | CO1 |
| **Unit-II** | **RANDOM SAMPLES** | **No. of Hours** | **COs** |
| | Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood, | 08 | CO2 |

| Unit-III | STATISTICAL INFERENCE | No. of Hours | COs |
|---|---|---|---|
| | Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment. | 08 | CO3 |
| Unit-IV | GRAPH THEORY | No. of Hours | COs |
| | Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles.Permutations and Combinations with and without repetition.<br>Specialized techniques to solve combinatorial enumeration problems | 07 | CO4 |
| Unit-V | COMPUTER SCIENCE AND ENGINEERING APPLICATIONS | No. of Hours | COs |
| | Computer science and engineering applications<br>Data mining, Network protocols, analysis of Web traffic, Computer security,<br>Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning. | 07 | CO5 |
| Unit-VI | RECENT TRANDS IN VARIOUS DISTRIBUTION FUNCTIONS | No. of Hours | COs |
| | Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision. | 07 | CO6 |

**Text Books:**

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.

**Reference Books:**

1. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
2. Alan Tucker, Applied Combinatorics, Wiley

| PCCO502: Advanced Data Structures | | | |
|---|---|---|---|
| **Teaching Scheme** | | **Examination Scheme** | |
| **Lectures: 3 Hrs./Week** | | **CIA** | : 40 Marks |
| **Tutorial:** | | **End-Semester Exam:** | : 60 Marks |
| **Credits: 3** | | **Total:** | : 100 Marks |
| **Prerequisite Course:** UG Courses for Data Structures | | | |

## Course Objectives:

1. To learn and understand of hash table and various collision resolution techniques in hashing.
2. To learn and understand skip lists for performing insertion, searching and updations.
3. To be acquainted with various types of trees like AVL, RBT, B-Tree, Splay Tree.
4. To learn and understand on various text processing algorithms.
5. To learn and understand computational geometry problems.
6. To know the recent trends and applications in hashing.

## Course Outcomes (COs):

After successful completion of the course, student will be able to

| | Course Outcome (s) | Bloom's Taxonomy | |
|---|---|---|---|
| | | **Level** | **Descriptor** |
| CO1 | Use concept of hash table and various collision resolution techniques in different applications | 3 | Apply |
| CO2 | Implement various operations on skip list. | 3 | Apply |
| CO3 | Design and analyze an algorithm for various types of trees like AVL, RBT, B-Tree, Splay Tree. | 4 | Analze |
| CO4 | Select and use an appropriate text processing algorithm. | 3 | Apply |
| CO5 | Identify suitable data structure and design algorithm for computational geometry problems. | 3 | Apply |
| CO6 | Demonstrate the recent trends and applications in hashing. | 3 | Apply |

| COURSE CONTENTS | | | |
|---|---|---|---|
| **Unit-I** | **DICTIONARIES AND HASHING** | **No. of Hours** | **COs** |
| | Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. <br> Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, QuadraticProbing, Double Hashing, Rehashing, Extendible Hashing. | 08 | CO1 |
| **Unit-II** | **SKIP LISTS** | **No. of Hours** | **COs** |
| | Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists | 08 | CO2 |
| **Unit-III** | **TREES** | **No. of Hours** | **COs** |

| | | No. of Hours | COs |
|---|---|---|---|
| | Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees | 08 | CO3 |
| **Unit-IV** | **TEXT PROCESSING** | **No. of Hours** | **COs** |
| | Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem. | 07 | CO4 |
| **Unit-V** | **COMPUTATIONAL GEOMETRY** | **No. of Hours** | **COs** |
| | Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees. | 07 | CO5 |
| **Unit-VI** | **RECENT TRANDS IN HASHING** | **No. of Hours** | **COs** |
| | Recent Trands in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem | 07 | CO6 |

**Text Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

**Reference Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

| PCCO503: Cloud Technology | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| Lectures: 3 Hrs./Week | CIA : 40 Marks | |
| Tutorial: | End-Semester Exam: : 60 Marks | |
| Credits: 3 | Total: : 100 Marks | |
| **Prerequisite Course:** Computer Network | | |

**Course Objectives:**

1. To learn and understand cloud computing fundamentals.

2. To learn and understand virtualization environment in cloud computing.

3. To learn and understand various cloud computing platforms.

4. To learn and understand the applications that uses cloud computing.

5. To learn and understand cloud monitoring and security aspects.

**Course Outcomes (COs):**

After successful completion of the course, student will be able to

| | Course Outcome (s) | Bloom's Taxonomy | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand the fundamentals and roots of cloud computing | 2 | Understand |
| CO2 | Install and create virtualization environments that forms the basics for cloud | 6 | Create |
| CO3 | Study and Analyse different cloud file systems. Compare available cloud file systems. | 4 | Analyse |
| CO4 | Develop Open source type of cloud | 6 | Create |
| CO5 | Understand Service Level Agreements in cloud services offered by cloud service provider to cloud service consumer. | 2 | Understand |
| CO6 | Design and Analyse the IoT sensor data by sending data on cloud. | 4 | Analyse |

| COURSE CONTENTS | | | |
|---|---|---|---|
| **Unit-I** | **INTRODUCTION CLOUD COMPUTING** | **No. of Hours** | **COs** |
| | Roots of Cloud Computing: Distributed computing (Cluster and Grid), Virtualization, Internet Techniques(Web services and SOA) & Autonomic computing. Cloud Fundamentals: cloud definition, hardware and software resources, benefits of cloud computing, limitations of cloud computing. | 08 | CO1 |
| **Unit-II** | **CLOUD ARCHITECTURE** | **No. of Hours** | **COs** |
| | Cloud computing reference model, Cloud computing service models and deployment models. Web Services, Service Oriented Architecture(SOA), Web service model, Web service components, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and XAMP) | 08 | CO2 |
| **Unit-III** | **VIRTUALIZATION** | **No. of Hours** | **COs** |

| | | No. of Hours | COs |
|---|---|---|---|
| | Virtualization: Definition, types of virtualization, types of hypervisors, virtualization tools and mechanisms- Xen, VMware. Issues with virtualization, advantages of virtualization. Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management. Virtualization for Data-Center Automation. | 08 | CO3 |
| **Unit-IV** | **DATA STORAGE IN CLOUD** | **No. of Hours** | **COs** |
| | Storage system architecture, Big data, Block and level storage virtualization, Virtual Provisioning, and automated storage tiering, VLAN, VSAN and benefits, Cloud file systems: GFS and HDFS, BigTable, Hbase and Dynamo. Features and comparisons among GFS, HDFS. Cloud Storage Providers. | 07 | CO4 |
| **Unit-V** | **CLOUD MONITORING AND MANAGEMENT** | **No. of Hours** | **COs** |
| | Interoperability and Service Monitoring: Issues with interoperability, Vendor lock-in, Interoperability approaches. SLA Management, Metering Issues, and Report generation. | 07 | CO5 |
| | Resource Management and Load Balancing: Virtual machine migration, Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management. | | |
| **Unit-VI** | **CLOUD AND THE INTERNET OF THINGS** | **No. of Hours** | **COs** |
| | Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Cyber-Physical System), Online Social and Professional Networking. | 07 | CO6 |

**Text Books:**

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, " Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more" , Wiley Publications, ISBN: 978-0-470-97389-9.
3. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476.

**Reference Books:**

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039.
2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0.

3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8.
4. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press.

| **PCCO504: Advanced Data Structures Lab** | |
|---|---|

| **Teaching Scheme** | **Examination Scheme** | |
|---|---|---|
| **Practical: 4 Hrs./Week** | **CIA** | **: Marks** |
| **Tutorial:** | **Oral Exam:** | **: 50 Marks** |
| **Credits: 2** | **Total:** | **: 50 Marks** |
| **Prerequisite Course:** Design and Analysis of Algorithms, Data Structures | | |

**Course Objectives:**

1. To be familiar with advanced data structure like hashing, skip list etc.

2. To use various types of search trees like AVL tree, Red-Black tree, B-tree.

3. To learn different algorithms for pattern matching or string matching.

4. To examine text processing with different algorithm like Huffman coding and dynamic programming algorithm.

**Course Outcomes (COs):**

After successful completion of the course, student will be able to

| **Course Outcome (s)** | **Bloom's Taxonomy** | |
|---|---|---|
| | **Level** | **Descriptor** |
| CO1 To design and implement advanced data structure like hashing , skip list | 3 | Apply |
| CO2 To design and implement various types of search trees like optimal binay search tree, AVL tree, Red-Black tree, B-tree. | 3 | Apply |
| CO3 To examine trie tree and brute-force algorithm and dynamic programming for pattern matching or string matching. | 4 | Analyze |
| CO4 To implement Huffman coding algorithm for text processing. | 3 | Apply |

| **Sr. No.** | **Assignment** |
|---|---|
| 1. | Write a menu driven program to implement all the functions of a phone book (ADT) using hashing. Data: Set of (key, value) pairs, Keys are mapped to values in the hash table and apply the following collision resolution techniques- (i) Linear Probing (ii) Quadratic Probing (iii) Chaining |
| 2 | Write a program to store k keys into an array of size n at the location computed using a hash function, loc = key % n, where k<=n and k takes values from [1 to m], m>n. To handle the collisions use the following collision resolution techniques. a. Quadratic probing     c. Double hashing/rehashing       d. linear probing with Chaining |
| 3. | For given set of elements create skip list. Find the element in the set that is closest to some given value. |
| 4. | A binary search tree containing n keys with order as k1<k2…<kn. Every key has search probability. Construct a binary search tree with least search cost for accessing each key in tree. |
| 5. | Construct AVL Tree with following operations: (consider nodes with integer type of data) a. Insertion: Test program for all cases (LL, RR, RL, LR rotation) b. Deletion: Test Program for all cases c. Display d. Find how many maximum comparisons may require for finding any keyword and the complexity for finding a keyword. |
| 6. | Construct a B-tree with order m=3, 5(m= non-leaf nodes have at most m children) . Perform operations as insertion, deletion and display operation on the given tree. |

| | |
|---|---|
| 7. | Write a program to implement Red-Black trees with insertion and deletion operation for the given input data as Strings. |
| 8. | Create a *Contacts* application using trie tree. The application must perform two types of operations:<br><br>3. Add name, where **name** is a string denoting a contact name. This must store name as a new contact in the application.<br>4. Find partial, where partial is a string denoting a partial name to search the application for. It must count the number of contacts starting with partial and print the count on a new line. |
| 9. | Construct a suffixed tree with brute force approach. Find out time complexity of brute force approach. |
| 10. | Write a program to print all the possible LCS presents in given two strings. Use dynamic programming approach to solve the problem. |
| 11. | A file contains the following characters with the frequencies as shown. If Huffman Coding is used for data compression, determine-<br><br>6. Huffman Code for each character<br>7. Average code length<br>8. Length of Huffman encoded message (in bits)<br><br>| Characters | Frequencies |<br>|---|---|<br>| A | 10 |<br>| E | 15 |<br>| I | 12 |<br>| O | 3 |<br>| U | 4 |<br>| S | 13 |<br>| T | 1 | |
| 12. | Write a program to construct priority search tree. |

**Text Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2004.

2. Michael T Goodrich, Roberto Tamassia, Algorithm Design and Applications, John Wiley,2002.

**Reference Books:**

1. Michael T Goodrich, Roberto Tamassia, Algorithm Design,Data Structures and Algorithms in C++,Second Edition John Wiley & Sons, Inc., 2011.

2. Ellis Horowitz ,Dinesh Mehta ,Sartaj Sahni ,Fundamentals of Data Structures in C++, University Press

| RMCO506: Research Methodology and IPR | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 4 Hrs./Week | CIA : 40 Marks |
| Tutorial: | End-Semester Exam: : 60 Marks |
| Credits: 4 | Total: : 100 Marks |
| **Prerequisite Course:** IPR and EDP | |

**Course Objectives:**

1. To introduce the concept, sources, and characteristics of a research problem.

2. To equip students with skills for data collection, analysis, and interpretation in research.

3. To develop proficiency in conducting effective literature reviews and maintaining research ethics.

4. To train students in technical writing, report preparation, and academic paper development.

5. To provide an understanding of the nature, process, and global aspects of Intellectual Property Rights (IPR).

6. To familiarize students with patent rights, licensing, technology transfer, and recent developments in IPR.

**Course Outcomes (COs):**

After successful completion of the course, student will be able to

| Course Outcome (s) | | Bloom's Taxonomy | |
|---|---|---|---|
| | | **Level** | **Descriptor** |
| CO1 | Identify and formulate a research problem with clarity, relevance, and feasibility. | 3 | Apply |
| CO2 | Use appropriate methodologies for data collection, analysis, and interpretation. | 4 | Analyze |
| CO3 | Conduct ethical and plagiarism-free literature reviews using credible sources. | 5 | Evaluate |
| CO4 | Demonstrate technical writing skills through structured reports and research papers. | 3 | Apply |
| CO5 | Explain the types, processes, and international procedures related to IPR and patents. | 2 | Understand |
| CO6 | Analyze real-world IPR cases and understand the implications of new developments in intellectual property. | 4 | Analyze |

| COURSE CONTENTS | | | |
|---|---|---|---|
| **Unit-I** | **Research problem** | **No. of Hours** | **COs** |
| | Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary | 10 | CO1 |

| | | | |
|---|---|---|---|
| | instrumentations | | |
| **Unit-II** | **EFFECTIVE LITERATURE STUDIES** | **No. of Hours** | **COs** |
| | Effective literature studies approaches, analysis<br>Plagiarism, Research ethics, | 10 | CO2 |
| **Unit-III** | **EFFECTIVE TECHNICAL WRITING** | **No. of Hours** | **COs** |
| | Effective technical writing, how to write report, Paper<br>Developing a Research Proposal, Format of research proposal, a presentation and assessment<br>by a review committee | 10 | CO3 |
| **Unit-IV** | **NATURE OF INTELLECTUAL PROPERTY** | **No. of Hours** | **COs** |
| | Nature of Intellectual Property: Patents, Designs, Trade and Copyright.<br>Process of Patenting and Development: technological research, innovation, patenting, development.<br>International Scenario: International cooperation on Intellectual Property.<br>Procedure for grants of patents, Patenting under PCT. | 10 | CO4 |
| **Unit-V** | **PATENT RIGHTS** | **No. of Hours** | **COs** |
| | Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. | 10 | CO5 |
| **Unit-VI** | **NEW DEVELOPMENTS IN IPR** | **No. of Hours** | **COs** |
| | New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. | 10 | CO6 |

**Text Books:**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

**Reference Books:**

1. Mayall , "Industrial Design", McGraw Hill, 1992.
2. Niebel , "Product Design", McGraw Hill, 1974.
3. Asimov , "Introduction to Design", Prentice Hall, 1962.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

## PCCO507: Data Analytics and Business Inelligence (NPTEL Course)

| Teaching Scheme | Examination Scheme | |
|---|---|---|
| Lectures: 2 Hrs./Week | CIA | : Marks |
| Tutorial: | End-Semester Exam: | : 50 Marks |
| Credits: 2 | Total: | : 50 Marks |
| Prerequisite Course: Data Mining | | |

### Course Objectives:

1. To learn & develop problem solving abilities using Mathematics.
2. To understand principles and methods of data analytics.
3. To learn & explore decision support systems.
4. To explore data Analytics life cycle.
5. To learn & manage BI Systems.
6. To learn advanced BI Tools.

### Course Outcomes (COs):

After successful completion of the course, student will be able to

| Course Outcome (s) | | Bloom's Taxonomy | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand fundamental concepts in Data Analytics & Business Intelligence. | 2 | Understand |
| CO2 | Apply Business Intelligence to Make Business Decisions. | 3 | Apply |
| CO3 | To demonstrate a survey on applications for Business Analytic and Intelligence. | 3 | Apply |
| CO4 | Ability to visualize the data. | 5 | Evaluate |
| CO5 | Apply recent BI Tools for various Applications. | 3 | Apply |
| CO6 | To write case studies in Data Analytics & Business Intelligence using mathematical models. | 6 | Create |

| COURSE CONTENTS | | | |
|---|---|---|---|
| Unit-I | DATA ANALYTICS | No. of Hours | COs |
| | Introduction: Data Analytics, Data Analytics life cycle, Discovery, Data preparation, Preprocessing requirements, Results & Findings, Operationalizing, Introduction to OLAP. Real-world Applications, types of outliers, outlier challenges, Outlier detection Methods, Proximity-Based Outlier analysis, Clustering Based Outlier | 05 | CO1 |
| Unit-II | DECISION MAKING CONCEPTS | No. of Hours | COs |
| | Concepts of Decision Making, Techniques of Decision Support System (DSS), Development of Decision Support System (DSS), The DSS Development Methodology, Change Management, DSS Technology Levels and Tools; DSS Development Platforms; Applications of DSS, Role of Business Intelligence in DSS. | 05 | CO2 |

| Unit-III | **INTRODUCTION TO BUSINESS INTELLIGENCE** | No. of Hours | COs |
|---|---|---|---|
| | Introduction to Business Intelligence, Defining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Benefits of BI. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization. | 05 | CO3 |
| Unit-IV | **ADVANCED BUSINESS INTELLIGENCE TOOLS** | No. of Hours | COs |
| | SAP Business Intelligence Tool, Yellowfin BI Tool, Microstrategy BI Tool for powerfull dashboarding & data analytics, Sisense BI Tool, SAS BI Tool, Microsoft Power BI  a web-based business analytics tool, Data analytics, business analytics, ERP and Business Intelligence, Looker BI Tool, Tableau  Business Intelligence tool for data discovery and data visualisation | 05 | CO4 |
| Unit-V | **DESIGNING AND MANAGING BI SYSTEMS** | No. of Hours | COs |
| | Introduction, Business Intelligence Lifecycle, Enterprise Performance Life Cycle (EPLC)Framework Elements, Life Cycle Phases, Human Factors in BI Implementation, BI Strategy, Objectives and Deliverables, Transformation Roadmap, Building a transformation roadmap, BI Development Stages and Steps, Parallel Development Tracks, BI Framework Determining infrastructure requirements, planning for scalability and availability, managing and maintenance of BI systems, managing BI operations for business continuity | 05 | CO5 |
| Unit-VI | **BUSINESS INTELLIGENCE IMPLEMENTATION & APPLICATIONS** | No. of Hours | COs |
| | Implementing Business Intelligence: Introduction, Business Intelligence Platform, Business Intelligence Platform Capability Matrix, BI Target Databases, Data Mart, BI Products and Vendor, The Big Four Business Intelligence vendors.<br>**BI Applications in:** CRM, Marketing, Logistics and Production, Finance, Banking, Telecommunications, Fraud Detection, Retail Industry. | 05 | CO6 |

**Text Books:**

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;
2. Anil Maheshwari, "Data Analytics" McGraw Hill Publication, ISBN: 9789352604180
3. Business Process Automation, Sanjay Mohapatra, PHI

**Reference Books:**

1. U. Dinesh Kumar, "Business Analytics", Willey, ISBN: 9788126568772, 8126568771
2. Introduction to business Intelligence and data warehousing, IBM, PHI.
3. Data mining concepts and techniques, Jawai Han, Michelline Kamber, Jiran Pie, Morgan Kaufmann Publishers 3rd edition
4. Data Mining for Business Intelligence, WILEY
5. Ken W. Collier,Agile Analytics: Avalue driven Approach to Business Intelligence and Data Warehousing, Pearson Education,2012, ISBN-13 978 8131786826

| PCCO508: Cloud TechnologyLab | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| Practical: 4 Hrs./Week | CIA | : Marks |
| Tutorial: | Oral Exam: | : 50 Marks |
| Credits: 2 | Total: | : 50 Marks |
| Prerequisite Course: | | |

| Course Objectives: |
|---|

1. To study cloud computing fundamentals.
2. To understand virtualization environment in cloud computing.
3. To study various cloud computing platforms.
4. To study the applications that uses cloud computing.
5. To study cloud monitoring and security aspects.

**Course Outcomes (COs):**

After successful completion of the course, student will be able to

| Course Outcome (s) | | Bloom's Taxonomy | |
|---|---|---|---|
| | | **Level** | **Descriptor** |
| CO1 | Understand the fundamentals and roots of cloud computing | 2 | Understand |
| CO2 | Install and create virtualization environments that forms the basics for cloud | 6 | Create |
| CO3 | Study and Analyse different cloud file systems. Compare available cloud file systems. | 4 | Analyse |
| CO4 | Develop Open source type of cloud | 6 | Create |
| CO5 | Understand Service Level Agreements in cloud services offered by cloud service provider to cloud service consumer. | 2 | Understand |
| CO6 | Design and Analyse the IoT sensor data by sending data on cloud | 4 | Analyse |

| Sr. No. | Assignment |
|---|---|
| 1. | Installation and configuration of own Cloud |
| 2 | Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System |
| 3. | Study and implementation of infrastructure as Service using Open Stack. |
| 4. | Write a program for Web feed using PHP and HTML |
| 5. | Assignment to install and configure Google App Engine. |
| 6. | Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store. |

**Text Books:**

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, " Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more" , Wiley Publications, ISBN: 978-0-470-97389-9.
3. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476.

**Reference Books:**

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039.
2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0.
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8.
4. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press.0262-01243-0