II विद्या विनयेन शोभते II

# Janardan Bhagat Shikshan Prasarak Sanstha's
# CHANGU KANA THAKUR
# ARTS, COMMERCE & SCIENCE COLLEGE,
# NEW PANVEL (AUTONOMOUS)

Re-accredited 'A+' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

## Program: Masters in Science (M. Sc.)

# SYLLABUS

## M.Sc.-I Computer Science

**Revised as per**

**Choice Based Credit & Grading System (60:40)**

**w.e.f. Academic Year 2023-24 as per NEP 2020**

# MASTERS IN SCIENCE (M. Sc.)
# Programme Outcomes

**After completion of M.Sc. Programme students will acquire**

| Sr. No. | After completion of M.Sc. program students will acquire | Graduate Attribute |
|---|---|---|
| PO1 | An ability to identify and describe broadly accepted methodologies of science, and different modes of reasoning. | Disciplinary knowledge |
| PO2 | An ability to demonstrate proficiency in various instrumentation, modern tools, advanced techniques and ICT to meet industrial expectations and research outputs. | Disciplinary knowledge/Digital literacy |
| PO3 | An ability to identify problems, formulates, and proves hypotheses by applying theoretical knowledge and skills relevant to the discipline. | Problem-solving |
| PO4 | An ability to articulate thoughts, research ideas, information, scientific outcomes in oral and in written presentation to a range of audience. | Communication skills |
| PO5 | A capacity for independent, conceptual and creative thinking, analysis and problem solving through the existing methods of enquiry. | Problem solving |
| PO6 | Skills required for cutting edge research, investigations, field study, documentation, networking, and ability to build logical arguments using scholarly evidence. | Research skills |
| PO7 | An ability to portray good interpersonal skills with ability to work collaboratively as part of a team undertaking a range of different team roles | Teamwork |
| PO8 | The ability to understand ethical responsibilities and impact of scientific solutions in global, societal and environmental context and contribute to the sustainable development | Moral and ethical awareness/ multicultural competence |
| PO9 | An ability to demonstrate leadership, to take action and to get others involved. | Leadership |
| PO10 | An openness to and interest in, life-long learning through directed and self-directed study | Self-directed learning |
| PO11 | An ability to translate the knowledge and demonstrate the skills required to be employed and successful professional development. | Life-long learning |

# Masters in Science (Computer)
# Syllabus for Semester I and II

## Preamble:

In accordance with the principles outlined in the National Education Policy (NEP), the educators and stakeholders of higher education in Computer Science, envision a dynamic and research-oriented learning experience for students pursuing their Master of Science degree in Computer Science. This program is designed to cultivate advanced knowledge, critical thinking, and practical skills in various domains of computer science, including research-based subjects such as analysis of algorithms, robotics, machine learning, compiler design, research methodology, wireless sensor networks, and advanced database management systems (ADBMS). Recognizing the rapidly evolving nature of the field and the increasing demand for skilled professionals, our goal is to equip students with a comprehensive understanding of theoretical concepts and practical applications in these specialized areas. The M.Sc. Computer Science program emphasizes the development of advanced analytical and problem-solving abilities, fostering a spirit of innovation and research within the discipline.

The curriculum is designed to provide students with a deep understanding of cutting-edge technologies and methodologies in computer science. Courses such as analysis of algorithms delve into the theoretical foundations of efficient algorithm design and optimization, enabling students to analyze and solve complex computational problems. Robotics explores the intersection of computer science and engineering, emphasizing the design and implementation of intelligent systems capable of autonomous decision-making and interaction with the physical world.

Machine learning, a rapidly growing field, equips students with the tools and techniques to develop algorithms that enable computers to learn and make predictions or decisions without explicit programming. Compiler design focuses on the theory and practice of translating high-level programming languages into machine code, essential for efficient program execution. Research methodology prepares students to undertake independent research, equipping them with skills in literature review, experimental design, data analysis, and scientific writing.

Wireless sensor networks encompass the study of distributed systems composed of interconnected sensors capable of gathering and transmitting data wirelessly, opening avenues for applications in environmental monitoring, healthcare, and smart cities. Advanced database management systems delve into the intricacies of data organization, storage, retrieval, and query optimization in large-scale databases, crucial for efficient and secure data management. Through this research-focused curriculum, we aim to foster a culture of intellectual curiosity, innovation, and critical inquiry among our students. The program encourages students to actively engage in research projects, collaborate with faculty members, and contribute to the body of knowledge in computer science through their own research endeavors.

Furthermore, the M.Sc. Computer Science program recognizes the importance of ethical considerations in research and the responsible use of technology. Students are encouraged to conduct their research with integrity, adhere to ethical guidelines, and consider the social implications of their work. This ensures that our graduates not only possess technical expertise but also act as ethical leaders and responsible contributors to the field.

We are committed to providing an inclusive and diverse learning environment that fosters equal opportunities for all students, regardless of their background. The M.Sc. Computer Science program promotes diversity, equity, and inclusion, encouraging students from diverse communities to participate actively and contribute to the advancement of computer science.

With the implementation of the National Education Policy as our guiding framework, we envision that the M.Sc. Computer Science program will produce highly skilled professionals and researchers who can address the evolving challenges and opportunities in the field. Our graduates will be equipped with the necessary knowledge, research acumen, and ethical mindset to make significant contributions to academia, industry, and society as a whole.

By embarking on this educational journey, we aim to empower our students to become lifelong learners, innovators, and leaders in the field of computer science, contributing to the advancement of knowledge and addressing the complex technological needs of the

contemporary world.

Additionally, we extend our gratitude to the members of the Board of Studies (BoS) for their valuable contributions in shaping the curriculum of the M.Sc. Computer Science program. Their expertise and insights have played a crucial role in ensuring that the syllabi align with the principles of the National Education Policy and meet the evolving needs of the industry and academia. We appreciate their dedication and commitment to maintaining academic excellence and fostering innovation in computer science education.

# PROGRAMME SPECIFIC OUTCOME (PSO)

| PSO | Description<br>After completing Master's Degree in Computer Science learners will be able to: |
|---|---|
| PSO 1 | Understand the core and advanced subjects of Computer Science and its logical application to solve real-life case studies using Emerging technologies |
| PSO 2 | Identify, analyze, and solve research based interdisciplinary computational problems |
| PSO 3 | Get exposure to modern software tools and lifelong learning for professional development |

# Scheme of Examination

- **Revised Scheme of Examination**

The performance of the learners shall be evaluated into two components. The learner's Performance shall be assessed by Internal Assessment with 40% marks in the first component by conducting the Semester End Examinations with 60% marks in the second component. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

**A) Internal Assessment**: 40 **%** **40 Marks**

| Sr. No. | Particular | Marks |
|---|---|---|
| 01 | One periodical class test / online examination to be conducted in the given semester | 20 Marks |
| 02 | Test on Practical Skills/ Case studies /Group/ Individual Survey Project/Presentation and write up on the selected topics of the subjects/ Test based on tutorials /Book Review / Open Book Test | 15 Marks |
| 03 | Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities | 05 Marks |

## *Question Paper Pattern*

### *(Periodical Class Test)*

Maximum Marks: 20 Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

| Question No. | Particular | Marks |
|---|---|---|
| Q-1 | Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) ( 1 Marks / 2 Marks each) | 10 Marks |
| Q-2 | Answer in Brief (Attempt any Two of the Three) (5 Marks each) | 10 Marks |

**B) Semester End Examination: 60 % 60 Marks**

- Duration: The examination shall be of 2 $\frac{1}{2}$ hours duration.

# Question Paper Pattern

| Theory question paper pattern |
|---|
| |
| 1. There shall be five questions each of 12 marks.<br>2. All questions shall be compulsory with internal options.<br>3. Questions may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit. |

❖ **Passing Standard**

The learners shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass the course and minimum of grade D in each project wherever applicable to pass a particular semester.

**I.** **Practical Examination :** – 150 (50 marks x 3 papers)

**II.** Each core subject carries: **- 50 Marks**

| Sr. No. | Particulars of External | Marks |
|---|---|---|
| 1 | Laboratory Work | 40 |
| 2 | Journal | 05 |
| 3 | Viva | 05 |
| | TOTAL | 50 |

Minimum 75 % practical from each core subject are required to be completed and written in the journal.

(Certified Journal is compulsory for appearing at the time of Practical Exam) --------

# Semester – I

## *[Under CBCS Scheme]*

| Course | Course code | Hrs./ week | Internal assessment | Semester-end examination on | Total | Credits |
|---|---|---|---|---|---|---|
| **Discipline Specific Course Mandatory** | | | | | | |
| Analysis of algorithm and Research Computing | PCS1ARC | 4 | 40 | 60 | 100 | 4 |
| Robotics | PCS1ROB | 4 | 40 | 60 | 100 | 4 |
| Wireless Sensor Network | PCS1WSN | 4 | 40 | 60 | 100 | 4 |
| Practical of AARC+Robotics | PCS1PPR1 | 4 | - | 50 | 100 | 2 |
| **Minor** | | | | | | |
| Research Methodology | PCS1REM | 4 | 40 | 60 | 100 | 4 |
| **Discipline Specific Electives (Anyone from the DSE List)** | | | | | | |
| Advance Database Management System | PCS1ADM | 2 | 40 | 60 | 100 | 4 |
| Machine Intelligence | PCS1MIN | 2 | 40 | 60 | 100 | 4 |
| Practical of WSN+ Elective | PCS1PPR2 | 4 | - | 50 | 100 | 2 |
| **Total Credits** | 22 | | | | | |

# Semester – II

## *[Under CBCS Scheme]*

| Course | Course code | Hrs. / week | Internal assessment | Semester-end examination | Total | Credits |
|---|---|---|---|---|---|---|
| **Discipline Specific Course Mandatory** | | | | | | |
| Cloud Computing | PCS2CLC | 4 | 40 | 60 | 100 | 4 |
| Natural Language Processing | PCS2NLP | 4 | 40 | 60 | 100 | 4 |
| Cryptography and Cryptanalysis | PCS2CRC | 4 | 40 | 60 | 100 | 4 |
| Practical of CC+NLP | PCS2PPR1 | 4 | 40 | 60 | 100 | 2 |
| **OJT/FP/CEP/RP** | | | | | | |
| On Job Training | | - | | | | 4 |
| **Discipline Specific Electives (Anyone from the DSE List)** | | | | | | |
| Business Intelligence and Big Data Analytics | PCS2BID | 2 | 40 | 60 | 100 | 4 |
| Machine Learning | PCS2MAL | 2 | 40 | 60 | 100 | 4 |
| Practical of CAC+ Elective | PCS2PPR2 | 4 | | | | 2 |
| **Total Credits** | 22 | | | | | |

| Course Description | |
|---|---|
| **Semester** | I |
| **Course Name** | Analysis of Algorithm and Research Computing |
| **Course Code** | PCS1ARC |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To recognize designing and backtracking techniques of an algorithm
- To cognize analysis techniques, number theoretic and Np completeness aspects of an algorithm
- To analyze various research problems and ways to solve specific problems
- To develop an approach towards research and implementation in the form of a research paper

**Course Outcomes:**

Learners will be able to:

- Describe advanced strategies of an algorithm
- Discuss the analysis techniques, number theoretic and NP completeness perspectives of an algorithm
- Discover a research problem and find a way to solve a specific research problem
- Create a research paper with professional skills

| Syllabus | | Total 60 L |
|---|---|---|
| **Unit I** | **Design strategies**<br>**The Role of Algorithms in Computing:** Algorithms as a technology.<br>**Getting Started:** Insertion sort, Analyzing algorithms, Designing algorithms. Growth of Functions: Standard notations and common functions.<br>**Divide-and-Conquer:** The maximum-subarray problem, | **15L** |

| | | |
|---|---|---|
| | Strassen's algorithm for matrix multiplication, The substitution method for solving recurrences. Probabilistic Analysis and **Randomized Algorithms:** The hiring problem, Indicator random variables, and Randomized algorithms. | |
| **Unit II** | **Advanced Design and Analysis Techniques**<br>**Dynamic Programming:** Rod cutting, Elements of dynamic programming, longest common subsequence.<br>**Greedy Algorithms:** An activity-selection problem, Elements of the greedy strategy, Huffman codes. Elementary Graph Algorithms: Representations of graphs, Minimum Spanning<br>**Trees:** Growing a minimum spanning tree, Algorithms of Kruskal and Prim. Single-Source Shortest<br>**Paths:** The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm. | **15L** |
| **Unit III** | **Number-Theoretic Algorithms and NP – Completeness**<br>Elementary number-theoretic notions, Greatest common divisor, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, NP-Completeness | **15L** |
| **UNIT IV** | **Optimization Techniques:** Maximum bipartite matching, Push relabel algorithms, The relabel-to-front algorithm The Flyod - Warshall Algorithm, The online paging problem, Adversary models, Paging against an oblivious adversary, Relating the adversaries, The adaptive online adversary, The kServer Problem<br>**String Matching :** The naïve string matching algorithm, Rabin Karp algorithm, Longest common subsequence (LCS), String matching with finite automata | **15L** |

**Text book:**

- Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI Learning Pvt. Ltd-New Delhi (2009)
- Researching Information Systems and Computing, Brinoy J Oates, Sage Publications India Pvt. Ltd (2006)

**References:**

- Algorithms, Sanjoy Dasgupta, Christos H. Papadimitriou, Umesh Vazirani, McGraw- Hill Higher Education (2006).
- Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, Aditya Bhargava, http://www.manning.com/bhargava

- Research Methodology, Methods and Techniques, Kothari, C.R.,1985, third edition, New Age International (2014)
- Basic of Qualitative Research (3rd Edition), Juliet Corbin & Anselm Strauss, Sage Publications (2008).
- Research Methodology, third edition by C. R. Kothari, Gaurav Garg


| Sr. No | List of Practical Experiments |
|---|---|
| 1 | Write a program to implement the Rod Cutting problem. |
| 2 | Write a program to implement a merge sort algorithm. Compare the time and memory complexity. |
| 3 | Given an array of numbers of length l. Write a program to generate a random permutation of the array using (i) permute-by-sorting () and (ii) permute-by-cyclic (). |
| 4 | Write a program to implement the Longest Common Subsequence (LCS) algorithm. |
| 5 | Write a program to implement Kruskal's algorithm. |
| 6 | Write a program to implement Dijkstra's algorithm. |
| 7 | Write a program to implement Euclid's algorithm to implement gcd of two non-negative integers a and b. Extend the algorithm to find x and y such that gcd(a,b) = ax+by. Compare the running time and recursive calls made in each case. |
| 8 | Write a program to verify (i) Euclid's theorem (ii) Fermat's theorem. |
| 9 | Write a program to implement a greedy set cover algorithm to solve the set covering problem. |
| 10 | Implement the following algorithm using an array as a data structure and analyze its time complexity. a. Bubble sort b. Radix sort c. Selection sort d. Heap sort e. Bucket sort f. Insertion sort |
| 11 | Implement N Queen's problem using Backtracking. |
| 12 | Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. |
| 13 | Implement Strassen's matrix multiplication Algorithm. |
| 14 | Write a program to find a solution for the knapsack problem using greedy methods. |
| 15 | Implement 0/1 Knapsack problem using Dynamic Programming. |

| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Designing strategies of an algorithm | 15h | 1 | 1 | 2 |
| 2 | Analysis techniques of an algorithm | 15h | 2 | 1 | 2 |
| 3 | Discover a research problem | 15h | 3 | 2 | 3 |

| **Course Description** | |
|---|---|
| **Semester** | I |
| **Course Name** | Robotics |
| **Course Code** | PCS1ROB |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To understand the working principles of physical components of robotic system
- To learn the internal and external perceptions of the robot based on different types of sensors
- To impart the knowledge about planning, mapping, and navigation of robot
- To provide hands-on practice to build actual robot

**Course Outcomes:**

Learners will be able to:

1. Describe the concepts of robotics and its components
2. Analyze the internal and external perceptions of the robot based on different types of sensors
3. Evaluate the planning, mapping, and navigation of robots
4. Construct a robot using Raspberry Pi

| | Syllabus | Total 45L |
|---|---|---|
| **Unit I** | **Introduction to Robotics:**<br>What is a Robot? Definition, History of Robots: Control Theory, Cybernetics, Grey Walter Tortoise, Analog Electronic Circuit, Reactive Theory, Braitenberg's Vehicle, Artificial Intelligence, Vision Based Navigation, Types of Robot Control. Robot Components: Embodiment, Sensors, States, Action, Brains and Brawn, Autonomy, Arms, Legs, Wheels, Tracks, and What really drives them effectors and actuators: Effector, Actuator, Passive and Active Actuation, Types of Actuator, Motors, Degree of freedom Locomotion: Stability, Moving and Gaits, Wheels and Steering, Staying on the path. Manipulators: End effectors, Teleoperation, Why is manipulation hard? Sensors: Types of Sensors, Levels of Processing, Passive and Active sensors, Switches, Light sensors, Resistive position sensor. | **15 L** |
| **Unit II** | **Sonar, Lasers and Cameras:**<br>Ultrasonic and Sonar sensing, Specular Reflection, Laser Sensing, Visual Sensing, Cameras, Edge Detection, Motion Vision, Stereo Vision, Biological Vision, Vision for Robots, Feedback or Closed Loop Control: Example of Feedback Control Robot, Types of feedback control, Feed forward or Open loop control. | **15 L** |
| **Unit III** | **Languages for Programming Robot:**<br>Algorithm, Architecture, The many ways to make a map, What is planning, Cost of planning, Reactive systems, Action selection, Subsumption architecture, How to sequence behavior through world, hybrid control, Behavior based control and Behavior Coordination, Behavior Arbitration, Distributed mapping, Navigation and Path planning. | **15 L** |
| **Unit IV** | **Building Robots With Raspberry Pi and Python:**<br>Hardware components of Raspberry pi, installation of Raspberry pi, Building Robot- ,Required Components, Assembling robot, Robot Movement-H-bridge, Programme Robot with predefined route, Line following using TCRT5000 sensor , Avoiding Obstacles-Ultrasonic sensors for analog object detection,HC-SR04 working and mounting, Measuring short distance | **15 L** |

**Text Books:**

- The Robotics Primer by Maja J Matarić, MIT press Cambridge, Massachusetts, London, England (2007).
- Learn Robotics With Raspberry Pi , Matt Timmons –Brown

| Sr. No. | List of Practical Experiments |
|---|---|
| **Perform following practical's using Robosim and JGameGrid** | |
| 1 | Write a program to create a robot with gear and move it forward, left, right. |
| 2 | Write a program to create a robot without gear and move it forward, left, right. |
| 3 | Write a program to create a robot with two motors and move it forward, left, right. |
| 4 | Write a program to do a square using a while loop. |
| 5 | Write a program to do steps with a for loop. |
| 6 | Write a program to change directions based on condition, controlling motor speed using switch case. |
| 7 | Write a program to create a robot with light sensors to follow a line. |
| 8 | Write a program to create a robot that does a circle using 2 motors . |
| 9 | Write a program to create a path following the robot. |
| 10 | Write a program to register obstacles. |
| **Perform following practical's using Raspberry Pi** | |
| 11 | Installation and hardware preparation of Raspberry Pi. |
| 12 | Build and assemble a robot using Raspberry Pi. |
| 13 | Add the sensor to the robot objects and develop line following behavior code. |
| 14 | Implement Line following using TCRT5000 sensor. |
| 15 | Implement Object detection using HC-SR04 sensor. |

| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Introduction to Robotics | 15h | 1 | 1 | 1 |
| 2 | Sonar, Lasers and Cameras | 15h | 2 | 3 | 2 |
| 3 | Languages for Programming Robot | 15h | 3 | 3 | 2 |
| 4 | Building Robots With Raspberry Pi and Python | 15h | 3 | 3 | 2 |

| Course Description | |
|---|---|
| **Semester** | I |
| **Course Name** | Wireless Sensor Network |
| **Course Code** | PCS1WSN |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To understand connection between different wireless devices and their compatibility
- To learn sensor node hardware & network architecture
- To conceptualize the framework of wireless network

**Course Outcomes:**

Learners will be able to:

1. Understand various applications of wireless sensor networks
2. Describe the concepts, protocols, design and implementation of wireless sensor networks.
3. Evaluate new ideas for solving wireless sensor network design issues

| Syllabus | | Total 60 L |
|---|---|---|
| **Unit I** | **Introduction:** Introduction to Sensor Networks, unique constraints and challenges. Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks.<br>**Sensor Node Hardware and Network Architecture:** Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC. Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts. | **15 L** |
| **Unit II** | **Medium Access Control Protocols:** Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study.<br>**Routing Protocols:** Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks.<br>**Transport Control Protocols:** Traditional Transport Control Protocols, 15L Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. | **15 L** |
| **Unit-III** | **Introduction to Wireless Transmission:** Applications, A short history of wireless communication.<br>**Wireless Transmission:** Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.<br>**Wireless Transmission Technology and Systems**: Radio Technology Primer, Available Wireless Technologies- Campus Applications, MAN/WAN Applications. | **15 L** |
| **Unit-IV** | **Applications of Wireless Sensor Networks :** Introduction, Background, Examples of Category 2 WSN Applications: Home Control, Building Automation, Industrial Automation, Medical Applications. Examples of Category 1 WSN Applications: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat | **15 L** |

| | | |
|---|---|---|
| | Monitoring, Nanoscopic Sensor Applications.<br>**Network Management for Wireless Sensor Networks:** Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues, Example of Management Architecture: MANNA, Other Issues Related to Network Management. | |

| **Sr. No.** | **List of Practical Experiments** |
|---|---|
| **Perform following practical's using INET Framework for OMNeT++, NetSim , TOSSIM, Cisco packet tracer 6.0 and higher version.** | |
| 1 | Understanding the Sensor Node Hardware. (For Eg. Sensors, Nodes(Sensor mote), Base Station, Graphical User Interface.) |
| 2 | Exploring and understanding TinyOS computational concepts:- Events, Commands and Task. - nesC model - nesC Components |
| 3 | Understanding TOSSIM for - Mote-mote radio communication - Mote-PC serial communication |
| 4 | Create and simulate a simple adhoc network |
| 5 | Understanding, Reading and Analyzing Routing Table of a network. |
| 6 | Create a basic MANET implementation simulation for Packet animation and Packet Trace. |
| 7 | Implement a Wireless sensor network simulation |
| 8 | Create MAC protocol simulation implementation for wireless sensor Network. |
| 9 | Simulate Mobile Adhoc Network with Directional Antenna |
| 10 | Create a mobile network using Cell Tower, Central Office Server, Web browser and Web Server. Simulate connection between them |
| 11 | Implementation /Simulation of any two Routing Protocols in Adhoc Networks. |
| 12 | Implementation /Simulation of any two Routing Protocols in Wireless Sensor |
| | Networks |
| 13 | Implementation /Simulation of any two MAC Protocols in Wireless Sensor Networks. |
| 14 | Network IP and basic network command and network configuration Commands, Simulation of Four Node Point to Point Network. |
| 15 | To implement and compare various MAC layer protocols. |

| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Introduction to Sensor Networks | 15h | 1 | 1 | 1 |
| 2 | Medium Access Control Protocols | 15h | 2 | 1 | 2 |
| 3 | Introduction to Wireless Transmission | 15h | 3 | 1 | 2 |
| 4 | Network Management for Wireless Sensor Networks | 15h | 4 | 1 | 2 |

| Course Description | |
|---|---|
| **Semester** | I |
| **Course Name** | Research Methodology |
| **Course Code** | PCS1RME |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To impart knowlede and skills requrired for research metodology.
- To gain the knowledge of research paper writing without violating professional ethics.

**Course Outcomes:**

Learners will be able to:

1. Formulate research problem and carry out research analysis
2. Follow research ethics.
3. Understand about IPR and filing patents in R & D.

| Syllabus | | Total 60 L |
|---|---|---|
| **Unit I** | **Research Methodology**<br>Objectives and motivation of research, Types of research , Research approaches , Significance of research , Research methods verses methodology , Research and scientific method ,Importance of research methodology , Research process ,Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations, Criteria of good research.<br>**Defining the research problem**: Definition of research problem, Problem Formulation, Necessity of defining the problem, Technique involved in defining a problem. | **15 L** |
| **Unit II** | **Literature survey and data collection:**<br>Importance of literature survey - Sources of information, Assessment of quality of journals and articles, Information through internet. Effective literature studies approaches, analysis, plagiarism, and research ethics, Data - Preparing, Exploring, examining and displaying. | **15 L** |
| **Unit-III** | **Research design and analysis** Meaning of research design, Need of research design , Different research designs , Basic principles of experimental design,Developing a research plan , Design of experimental set-up , Use of standards and codes, Overview of Multivariate analysis, Hypotheses testing and Measures of Association, Presenting Insights and findings using written reports and oral presentation. | **15 L** |
| **Unit-IV** | **Intellectual property rights (ipr)**<br>Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions. | **15 L** |

**Text book:**


1. Peter S. Menell ,Mark A. Lemley, Robert P. Merges, "Intellectual Property in the New Technological "Vol. I Perspectives, 2021.
2. Laura R. Ford,"The Intellectual Property of Nations: Sociological and Historical Perspectives on a Modem Legal Institution Paperback -2021.
3. 1. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
4. RatanKhananabis and SuvasisSaha, "Research Methodology", Universities Press, Hyderabad, 2015.
5. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, I l e (2012).
6. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
7. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
8. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
9. Ranjit Kumar, 2nd Edition,"Research Methodology: A Step by Step Guide for beginners"2010


| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Research Methodology | 15h | 1 | 1 | 2 |
| 2 | Literature survey and data collection: | 15h | 2 | 2 | 3 |
| 3 | Research design and analysis | 15h | 2 | 2 | 3 |
| 4 | Intellectual property rights (ipr) | 15h | 2 | 2 | 3 |

| **Course Description** | |
|---|---|
| **Semester** | I |
| **Course Name** | Advanced Database Systems |
| **Course Code** | PCS1ADS |
| **Eligibility for the Course** | B.Sc. |
| **Credit** | 2 |
| **Hours** | 30 |

**Course Objectives:**

- To understand distributed database systems.
- To explore the concepts of object-oriented, temporal, spatial databases and deductive database.

**Course Outcomes:**

Learners will be able to:

1. Describe the concept of distributed database systems.
2. Illustrate data modeling and database development processes for object-oriented, temporal, spatial databases and deductive database.

| Syllabus | | Total 30 L |
|---|---|---|
| **Unit I** | **Distributed Database Concepts**<br>Definition of Distributed databases and Distributed Database Management System (DDBMS), Distributed transparent system. DDBMS Architecture: DBMS standardization, Global, Local, External, and Internal Schemas, Architectural models for DDBMS. Distributed database design: Design problem of distributed systems, Design, strategies (top-down, bottom-up), Fragmentation, Allocation and replication of fragments. Query Processing Overview, Query Optimization.<br>**Concepts of Transaction Management and Concurrence Control:**<br>Transaction Management: Definition and examples, formalization of a transaction, ACID properties, classification of transaction. Concurrency Control: definition, execution schedules, examples, locking based algorithms, timestamp ordering algorithms, deadlock management. | **15 L** |

| Sr. No | List of Practical Experiments |
|---|---|

| | | |
|---|---|---|
| **Unit II** | **Object Oriented, Temporal and Spatial Databases:**<br>**Object Oriented Database:** Object Identity, Object structure, Type Constructors, Encapsulation of Operations, Methods, Persistence, Type and Class Hierarchies, Inheritance, Complex Objects, Object-oriented DBMS, Languages and Design: ODMG Model, Object Definition Languages (ODL), Object Query Languages (OQL). Temporal and Spatial Database: Introduction to Temporal Database: Time ontology, structure, and granularity, Temporal data models, Temporal relational algebras. Introduction to Spatial Database: Definition, Types of spatial data, Geographical Information Systems (GIS), Conceptual Data Models for spatial databases, Logical data models for spatial databases: raster and vector model. Physical data models for spatial databases: Clustering methods (space filling curves), Storage methods (R-tree). Query processing.<br>**Deductive Database:** Introduction to recursive queries, Datalog Notation, Clause Form and Horn Clauses, Interpretation of model: Least Model semantics, The fixed point operator, safe Datalog program, recursive query with negation. | **15L** |

**Text books:**


- Distributed Database; Principles & Systems By Publications, Stefano Ceri and Giuseppo Pelagatti,, McGraw-Hill International Editions (1984)
- Database Management Systems, 3rd edition, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill (2002).
- Fundamentals of Database Systems, 6thEdition, Elmasri and
- Navathe, Addison. Wesley (2003).
- Unifying temporal data models via a conceptual model, C.S. Jensen, M.D. Soo, and R.T. Snodgrass: Information Systems, vol. 19, no. 7, pp. 513-547, 1994.
- Spatial Databases: A Tour by Shashi Shekhar and Sanjay Chawla, Prentice Hall, 2003 (ISBN 013-017480-7)
- Principles of Multimedia Database Systems, Subramanian V. S. Elsevier Publishers, 2013


**References:**


- Principles of Distributed Database Systems; 2nd Edited By M. Tamer Ozsu and Patrick Valduriez, Pearson Education Asia. · Database System Concepts, 5th edition, Avi Silberschatz
- , Henry F. Korth , S. Sudarshan: McGraw-Hill (2010)

- Database Systems: Concepts, Design and Applications, 2nd edition, Shio Kumar Singh, Pearson Publishing, (2011).
- Multi-dimensional aggregation for temporal data. M. Böhlen, J. Gamper, and C.S. Jensen. In Proc. of EDBT-2006, pp. 257-275, (2006).
- Moving objects databases (chapter 1 and 2), R.H. Güting and M. Schneider: Morgan Kaufmann Publishers, Inc., (2005)
- Advanced Database Systems, (chapter 5, 6, and 7), Zaniolo et al.: Morgan Kaufmann Publishers, Inc., (1997)


| | |
|---|---|
| 1 | Create table sales_order ( to store client's orders) and sales_order_details (used to store client's orders with details of each product ordered ) Retrieve the structure of the tables. Retrieve all the attributes of all the tables. |
| 2 | For a given global conceptual schema, divide the schema into vertical fragments and Place the replication of the global conceptual schema on different nodes and execute queries that will demonstrate a distributed database environment. |
| 3 | For a given global conceptual schema, divide the schema into horizontal fragments and place them on different nodes. Execute queries on these fragments that will demonstrate a distributed database environment. |
| 4 | Place the replication of global conceptual schema on different nodes and execute queries that will demonstrate a distributed database environment |
| 5 | Create different types that include attributes and methods. Define tables for these types by adding a sufficient number of tuples. Demonstrate insert, update and delete operations on these tables. Execute queries on them |
| 6 | Create a temporal database and issue queries on it. |
| 7 | Create a table that stores spatial data and issue queries on it. |

| **Module/ Unit** | **Course Description** | **Hrs.** | **CO No.** | **PSO No.** | **PO No.** |
|---|---|---|---|---|---|
| 1 | Distributed Database Concepts | 15h | 1 | 1 | 1 |
| 2 | Object Oriented, Temporal and Spatial Databases, Deductive Database | 15h | 2 | 3 | 1,3 |

| **Course Description** | |
|---|---|
| **Semester** | I |

| | |
|---|---|
| **Course Name** | Machine Intelligence |
| **Course Code** | PCS2MIN |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To be able to formulate machine learning problems corresponding to different applications.
- To understand various machine learning algorithms along with their advantages and disadvantages.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.

**Course Outcomes:**

Learners will be able to:

1. Understand the basic concepts and types of learning from data.
2. Analyze the models using different Machine Learning techniques.
3. Create probabilistic and unsupervised learning models for handling unknown patterns.

| **Syllabus** | | **Total 60 L** |
|---|---|---|
| **Unit I** | **Learning-Standard Linear methods:** Statistical Learning: What Is Statistical Learning, Assessing Model Accuracy, Linear Regression: Simple Linear Regression, Multiple Linear Regressions, and Other Considerations in the Regression Model, The Marketing Plan, and Comparison of Linear Regression with K-Nearest Neighbors, Classification: An Overview of Classification, Why Not Linear Regression? , Logistic Regression, Linear Discriminant Analysis, A Comparison of Classification Methods. | **15 L** |

| | | |
|---|---|---|
| **Unit II** | **Selection and improvements of linear learning methods:**<br>Resampling Methods: Cross-Validation, The Bootstrap. Linear Model Selection and Regularization: Subset Selection, Shrinkage Methods, Dimension Reduction Methods, Considerations in High Dimensions. | **15 L** |
| **Unit III** | **Non-Linear Learning methods:**<br>Polynomial Regression, Step Functions, Basis Functions, Regression Splines, Smoothing Splines, Local Regression, Generalized Additive Models.<br>**Tree-Based Methods:** The Basics of Decision Trees. Bagging, Random Forests, Boosting. | **15 L** |
| **Unit IV** | **Support Vector machines, Principal Component Analysis and Clustering:**<br>Support Vector Machines: Maximal Margin Classifier. Support Vector Classifiers: Support Vector Machines, SVMs with More than Two Classes Relationship to Logistic Regression. Unsupervised Learning: The Challenge of Unsupervised Learning, Principal Components Analysis, Clustering, Methods: K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering. | **15 L** |

**Text books:**


- An Introduction to Statistical Learning with Applications in R: Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer 2013.
- The Elements of Statistical Learning: Data Mining, Inference, and Prediction (Second Edition) : Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer (2008).

**References:**


- Introduction to Machine Learning (Second Edition): Ethem Alpaydın, The MIT Press (2010).
- Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer (2006)
- Bayesian Reasoning and Machine Learning: David Barber, Cambridge University Press (2012)
- Machine Learning: The Art and Science of Algorithms that Make Sense of Data: Peter Flach, Cambridge University Press (2012) Machine Learning for Hackers: Drew Conway and John Myles White, O'Reilly (2012)
- Machine Learning in Action: Peter Harrington, Manning Publications (2012).
- Machine Learning with R: Brett Lantz, Packt Publishing (2013)


| Sr. No. | List of Practical Experiments |
|---|---|
| **1** | Implement a simple linear regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Boston, Auto etc] |
| **2** | Implement multiple regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Carseats, Boston etc]. |
| **3** | Fit a classification model using logistic regression on a standard data set and compare the results. [Inbuilt datasets like Smarket, Weekly, Auto, Boston etc may be used for the purpose]. |
| **4** | Fit a classification model using following:<br>(i) Linear Discriminant Analysis (LDA)<br>(ii) Quadratic Discriminant Analysis (QDA)<br>[Inbuilt datasets like Smarket, Weekly, Auto, Boston etc may be used for the purpose]. |
| **5** | Fit a classification model using K Nearest Neighbour (KNN) Algorithm on a given data set. [One may use data sets like Caravan, Smarket, Weekly, Auto and Boston]. |
| **6** | Use bootstrap to give an estimate of a given statistic. [Datasets like Auto, Portfolio and Boston etc may be used for the purpose]. |
| **7** | For a given data set, split the data into two training and testing and fit the Linear model using least squares training set. |

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| **8** | For a given data set, split the data into two training and testing and fit the following on training set:<br>(i) Ridge regression model<br>(ii) Lasso model<br>Report test errors obtained in each case and compare the results. [Data sets like College, Boston etc may be used for the purpose]. |
| **9** | For a given data set, split the data into two training and testing and fit the following on the training set:<br>(i) PCR model<br>(ii) PLS model<br>Report test errors obtained in each case and compare the results. [Data sets like College, Boston etc may be used for the purpose]. |
| **10** | For a given data set, Perform the polynomial regression and make a plot of the resulting polynomial fit to the data.<br>Make a plot of the fit to the data. [Use a data set like Wage for the purpose]. |
| **11** | For a given data set, Fit a step function and perform cross validation to choose the optimal number of cuts. Make a plot of the fit to the data. [Use a data set like Wage for the purpose]. |
| **12** | For a given data set, do the following:<br>(i) Fit a classification tree<br>(ii) Fit a regression tree<br>[One may choose data sets like Carseats, Boston etc for the purpose]. |
| **13** | For a given data set, split the dataset into training and testing. Fit the following models on the training set and evaluate the performance on the test set:<br>(i) Boosting<br>(ii) Bagging<br>(iii) Random Forest<br>[Data sets like Boston may be used for this purpose]. |
| **14** | Fit a support vector classifier for a given data set. [Data sets like Car, Khan, Boston etc may be used for the purpose]. |
| **15** | Perform the following on a given data set:<br>(i) Principal Component Analysis<br>(ii) Hierarchical clustering.<br>[Data set like NC160, USArrests etc may be used for the purpose]. |

Note: The above practical experiments require the R Software

| Module /Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Learning-Standard Linear methods: | 15h | 1 | 1 | 1 |
| 2 | Selection and improvements of linear learning methods & Non-Linear Learning methods | 15h | 2 | 2 | 2 |
| 3 | Tree-Based Methods & Support Vector machines, Principal Component Analysis and Clustering: | 15h | 3 | 2 | 2 |

# Semester II

| Course Description | |
|---|---|
| **Semester** | II |
| **Course Name** | Cloud Computing |
| **Course Code** | PCS2CLC |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To provide comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, and architecture
- To analyze different cloud computing platforms for implementing solutions
- To expose the students to frontier areas of Cloud Computing Management services
- To make students aware of security threats in cloud computing

**Course Outcomes:**

Learners will be able to

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
2. Identify problems, and explain, analyze, and evaluate various cloud computing platforms for the solution
3. Implement different types of Service Oriented Architecture systems
4. Analyze the issues in Resource provisioning and Security governance in clouds

| Syllabus | | Total 60 L |
|---|---|---|
| **Unit I** | **Introduction:**<br>Introduction, Roots of Cloud Computing: From mainframe to Cloud, Benefits of Cloud Computing SOA, Web services, Web 2.0, Mashups, Grid computing, Utility computing, Hardware virtualization, Essentials of Cloud characteristics, Challenges, Cloud economics, Role of Networks in Cloud Computing: Cloud types and service models.<br>**Security in Cloud Computing:**<br>Introduction, Global Risk and Compliance aspects in cloud environments and key security terminologies | **15L** |
| **Unit II** | **Cloud Platforms:**<br>Features of Cloud and Grid Platforms: Cloud Capabilities and Platform Features, Traditional Features Common To Grids and Clouds, Data Features and Databases, Programming and Runtime Support. Parallel and Distributed Programming Paradigms: Parallel Computing and Programming Paradigms, MapReduce, Twister and Iterative MapReduce, Hadoop Library from Apache.<br>**Examples:** Openstack, Opennimbus, Eucalyptus Primary Cloud Service models, GAE, AWS, and Azure: Public Clouds and Service Offerings, Google App Engine (GAE), Amazon Web Service (AWS), Microsoft Windows Azure | **15L** |

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| **Unit III** | **Management of cloud services**<br>Reliability, availability, and security of services deployed from the cloud. Performance and scalability of services, tools, and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud-based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon,<br>Microsoft and Google, Salesforce.com, Ubuntu and Redhat) | **15L** |
| **Unit IV** | **Security in Cloud Computing**<br>Introduction, Global Risk and Compliance aspects in cloud environments and key security terminologies, Technologies for Data security, Data security risk, Cloud computing and identity, Digital identity and access management, Content level security, Security-As-A-Cloud Service | **15L** |

**Text book:**

- Rajkumar Buyya, "Cloud computing principles and paradigms", Wiley
- Gautam Shroff, Enterprise Cloud Computing, Cambridge
- Rajkumar Buyya, "Mastering Cloud computing", McGraw Hill
- Tim Mather, Subra K, Shahid L.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5
- Distributed and cloud computing from parallel processing to the internet of things by Kai Hwang, Geoffry C. Fox, and Jack J. Dongarra

**References:**

- Kai Hwang, Jack Dongarra, Geoffrey Fox: Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, MK Publishers, 2012. 2.
- Michael Miller, Cloud Computing: Web-Based Applications that change the Way you work and collaborate Online, Pearson Publication, 2012.
- Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication

| Sr. No. | List of Practical Experiments |
|---|---|
| 1 | Develop Applications using Google AppEngine |
| 2 | Implement MapReduce and Hadoop |
| 3 | Implement private cloud with Xen server |
| 4 | Creating a Failover Cluster using Failover Cluster Manager |
| 5 | Implement private cloud with Exi server |
| 6 | Installation and Configuration of virtualization using KVM |
| 7 | Study and implement Cloud Security management with Two-Factor Authentication |
| 8 | Study and implementation of Single-Sing-On |
| 9 | Managing Hyper-V environment with SCVVM 2012 |
| 10 | Using Data Protection Manager for Backup and Recovery |
| 11 | Show the implementation of web service and perform arithmetic operations (addition, division). |
| 12 | Implement virtualization using VMWare ESXi Server. |
| 13 | Study and Implementation of single-sign-on. |
| 14 | Develop application for Google App Engine |
| 15 | Write a program for implementing a Client Server communication model using TCP. |

| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Introduction | 15h | 1 | 1 | 1 |
| 2 | Cloud Platforms | 15h | 2 | 2 | 2 |
| 3 | Management of cloud services | 15h | 3 | 3 | 3 |
| 4 | Security in Cloud Computing | 15h | 4 | 2 | 8 |

| **Course Description** | |
|---|---|
| **Semester** | II |
| **Course Name** | Natural Language Processing |
| **Course Code** | PCS2NLP |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course objectives:**

- To understand the core concepts of Natural language processing and levels of language analysis
- To understand the basic algorithms and techniques used in NLP, such as word, syntactic, semantic and sentiment analysis.
- To examine the concept of Word Sense Disambiguation, Part of Speech (PoS) tagging

**Course outcomes:**

Learners will be able to

1. Design and implement NLP applications that solve real-world problems such as sentiment analysis, named entity recognition, and machine translation.
2. Develop practical skills in implementing NLP techniques for word level, syntactic, and semantic analysis to solve real-world problems.
3. Demonstrate a solid understanding of the fundamental concepts and techniques of NLP, including linguistic theories, parsing, tokenization, and part-of-speech tagging

| Syllabus | | Total 60L |
|---|---|---|
| **Unit I** | **Introduction to Natural Language Processing:** Basic concepts of Natural language Processing, Evolution of NLP, Features and Applications of NLP, Issues and Challenges in NLP, Phases of NLP, Levels of Analysis: Phonetics, Phonology, Morphology, Syntax, Semantics, Sentiment and Pragmatics ,Tools and techniques used for performing these analysis, ambiguities, Types of ambiguities.<br>**Linguistic Resources:** Corpus, elements of corpus design, TreeBank corpus, ProBank corpus, VerbNet, WordNet, elements of Noun, Verb, Adjective, Adverbial phrases, Top down and Bottom up parser(Stanford parser) | **15L** |
| **Unit II** | **Word Level Analysis:** Regular Expressions, Properties and Examples of Regular Expressions, Regular Sets & Their Properties, Finite State Automata, Relation between Finite Automata, Regular Grammars and Regular Expressions, Types of Finite State Automaton (FSA), Morphological Parsing, Types of Morphemes.<br>**Syntactic Analysis:** Parser, Derivation, Parse Tree, Grammar, Phrase Structure or Constituency Grammar, Dependency Grammar, Context Free Grammar | **15L** |
| **Unit III** | **Semantic & Sentiment Analysis:** Elements of Semantic Analysis, Homonymy, Polysemy, Synonymy, Hyponymy, Meaning Representation, Approaches to Meaning Representations, Need of Meaning Representations, Lexical Semantics, Importance of sentiment analysis, Types and challenges of sentiment analysis | **15L** |

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| **Unit IV** | **Word Sense Disambiguation:** Evaluation of WSD, Approaches, Methods , Applications and Difficulties in WSD, Word Sense Disambiguation (WSD) Applications: Named Entity Recognition, Information retrieval, Question answers system, Machine translation<br>**Discourse Processing:** Concept of coherence, Discourse structure, Algorithms for Discourse Segmentation, Text coherence, Reference Resolution.<br>**Part of Speech Tagging(Pos):** Rule-based, Stochastic, Transformation-based, Hidden Markov Model PoS Tagging | |

**Text Books:**


1. Daniel Jurafsky, James H. Martin ―Speech and Language Processing‖ Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and Hinrich Schutze, ― Foundations of Statistical Natural Language Processing ―, MIT Press, 1999.
3. D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education, 2002.


**References:**


1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. https://monkeylearn.com/sentiment-analysis
3. Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications‖ Pearson, 2013
4. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) ― The Handbook of Computational Linguistics and Natural Language Processing ― ISBN: 978-1-118
5. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly

5. Brian Neil Levine, An Introduction to R Programming

6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial: An introduction into R application and programming

7. Christopher D. Manning, Hinrich Schutze, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts, 1999.

| **Sr. No.** | **List of Practical Experiments on Natural Language Processing** |
|---|---|
| Note: - The following set of practicals can be performed using any Python Libraries for NLP such as NLTK, spaCy, genism: Link:-https://www.python.org/downloads/ | |
| 1 | Write a program to implement sentence segmentation and word tokenization |
| 2 | Write a program to implement stemming and lemmatization |
| 3 | Write a program to implement a tri-gram model |
| 4 | Write a program to implement PoS tagging using HMM & Neural Model |
| 5 | Write a program to implement syntactic parsing of a given text |
| 6 | Write a program to implement dependency parsing of a given text |
| 7 | Write a program to implement Named Entity Recognition (NER) |
| 8 | Write a program to implement Text Summarization for the given sample text |
| 9 | Write a program to classify the sentiment of a given text as positive, negative, or neutral. |
| 10 | Write a program to convert speech to text and text to speech. |
| 11 | Write a program to extract structured information from unstructured text, such as dates, addresses, and phone numbers. |
| 12 | Write a program to build a system that translates text from one language to another. |
| 13 | Write a program to develop a system to retrieve relevant information from a large |

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|---|---|
| | collection of documents based on user queries. |
| 14 | Write a program to predict the next word in a given sequence of words, enabling tasks like autocomplete or text generation. |
| 15 | Write a program to develop algorithms or use existing libraries to assign appropriate PoS tags to words in a given text. |

| **Module /Unit** | **Course Description** | **Hrs.** | **CO No.** | **PSO No.** | **PO No.** |
|---|---|---|---|---|---|
| 1 | Introduction to NLP & Linguistic Resources | 15h | 1 | 1 | 1 |
| 2 | Word Level, Syntactic, Semantic, Sentiment Analysis | 15h | 2 | 2 | 3 |
| 3 | Word Sense Disambiguation, Discourse Processing and Part of Speech Tagging(Pos) Tagging | 15h | 3 | 2 | 3 |

| **Course Description** | |
|---|---|
| **Semester** | II |
| **Course Name** | Security(Cryptography and Cryptanalysis) |
| **Course Code** | PCS2CRC |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To understand cryptography and its applications.
- To develop a basic understanding of cryptographic mechanisms.
- To understand the working of symmetric cipher
- To understand the working of hash function and digital signature

**Course Outcomes:**

Learners will be able to

1. Analyze the modes of attacks and security threats
2. Understand the hierarchy of cipher
3. Interpret the working of DES
4. Interpret the working of RSA cryptosystem

| **Syllabus** | | **Total 60 L** |
|---|---|---|
| **Unit I** | **Introduction and Classical Ciphers:**<br>**Security:** Computer Security, Information Security, Network Security, **CIA Triad:** Confidentiality, Integrity, Availability, Cryptography, Cryptosystem, Cryptanalysis, Security Threats:,<br>**Attacks:** Passive (Release of message, Traffic analysis), Active (Replay, Denial of service)<br>**Security Services:** Authentication, Access Control, Nonrepudiation Security Mechanisms, Policy and Mechanism<br>**Classical Cryptosystems:** Hierarchy of cipher<br>**Substitution Techniques:-** Monoalphabetic: Caesar Cipher, Hill<br>- Polyalphabetic: Vigenere Cipher (Variants: vernam , one time pad), Playfair<br>**Transposition Techniques:** Rail Fence Cipher, simple columnar **Modern Ciphers:** Block Ciphers, Stream Ciphers, Symmetric Ciphers, Asymmetric Ciphers | **15 L** |

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|---|---|---|
| **Unit II** | **Symmetric Ciphers:**<br>Feistel Cipher Structure, Substitution Permutation Network (SPN) **Finite Fields:** Basic concepts of Groups, Rings, and Fields, GCD, Euclidean Algorithm, Modular Arithmetic, Set of Residue (Zn), Congruence, Residue classes, Quadratic residue, Operations on Zn (Addition, Subtraction, Multiplication), Properties of Zn, Inverses: Additive Inverse, Multiplicative Inverse, Relatively Prime, Extended Euclidean Algorithm, Galois Fields (GF(p) & GF(2n)), Polynomial Arithmetic : Addition, Multiplication and Division over Galois Field, **blowfish & International Data Encryption Standard (IDEA):** Key Generation, Encryption and Decryption Process<br>**Data Encryption Standards (DES):** Key Generation, Encryption and Decryption Process<br>Modes of Block Cipher Encryptions (Electronic Code Book, Cipher Block Chaining, Cipher Feedback Mode, Output Feedback Mode, Counter Mode)<br>Message Authentication, Message Authentication Functions, Message Authentication Codes, Hash Functions, Properties of Hash functions, Applications of Hash Functions | 15 L |
| **Unit III** | **Asymmetric Ciphers & Cryptographic Hash Functions, Digital Signatures:**<br>**Public Key Cryptosystems:** Applications of Public Key Cryptosystems<br>**Distribution of public key:** Distribution of secret key by using public key cryptography,Diffie-Hellman Key Exchange, Man-in-the-Middle Attack<br>**Digital Signatures:** Direct Digital Signatures, Arbitrated Digital Signature<br>**Digital Signature Standard:** The DSS Approach, Digital Signature Algorithm(DSA)<br>**Message Digests:** Details of MD4 and MD5 algorithms | 15 L |

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|---|---|---|
| **Unit IV** | **RSA Cryptosystem:**<br>The RSA Algorithm, Primarily Testing, Legendre and Jacobi Symbols, The Solovay Strassen Algorithm, The Miller-Rabin Algorithm, Factoring Algorithm: The pollard p-1 Algorithm, Dixon's Random Squares Algorithm, Attacks on RSA, The Rabin Cryptosystem. Public Key Cryptosystems: The idea of public key Cryptography, The Diffie-Hellman Key Agreement, ElGamal Cryptosystem, The Pollard Rho Discrete Logarithm Algorithm, Elliptic Curves, Knapsack problem. | 15 L |

**Text Books**

- W. Stallings, Cryptography and Network Security: Principles and Practice
- Cryptography and Network Security – by Atul Kahate – TMH. Cryptography: Theory and Practice, Douglas Stinson, CRC Press, CRC Press LLC

**References**

- Cyber Security Operations Handbook – by J.W. Rittinghouse and William M.Hancok – Elseviers
- Information Security and cyber laws, Saurabh Sharma, student series, Vikas publication.
- Encryption, Ankit Fadia and J. Bhattacharjee, Vikas publication
- Cryptography and Network Security by Behrouz A. Forouzan, TATA McGraw hill.

| Sr. No | List of Practical Experiments |
|---|---|
| 1 | Implement following Substitution Ciphers<br>a. Caesar Cipher<br>b. Modified Caesar Cipher |
| 2 | Implement following Substitution Ciphers<br>a. Mono-Alphabetic<br>b. Poly-Alphabetic |
| 3 | Implement following Transposition Ciphers<br>a. Rail fence Techniques<br>b. Simple Columnar |
| 4 | Implement following Transposition Ciphers<br>a. Multicolumnar<br>b. Vernam Cipher |
| 5 | Implement RC4 |
| 6 | Implement RC5 |
| 7 | Implement DES |
| 8 | Implement blowfish |
| 9 | Implement IDEA |
| 10 | To implement the Signature scheme-Digital Signature Standard |
| 11 | To calculate the message digest of a text using the SHA-1 algorithm |
| 12 | To calculate the message digest of a text using the MD5 algorithm |
| 13 | Write a program to implement the DSA Algorithm to perform encryption and decryption. |
| 14 | To implement Diffie Hellman key exchange algorithm |
| 15 | Implement hash functions |

| Module/ Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Introduction | 15h | 1 | 1 | 1 |
| 2 | Symmetric cipher | 15h | 2 | 3 | 2 |
| 3 | Asymmetric cipher | 15h | 3 | 3 | 2 |
| 4 | RSA Cryptosystem | 15h | 4 | 3 | 2 |

| **Course Description** | |
|---|---|
| **Semester** | II |
| **Course Name** | Business Intelligence and Big data Analytics |
| **Course Code** | PCS2BI1 |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 4 |
| **Hours** | 60 |

**Course Objectives:**

- To apply the basic concepts and methods of business analytics and data warehouse.
- To improving strategic decision-making by designing a Data Warehouse model.
- To explore data mining concepts and solutions.

**Course Outcomes:**

Learners will be able to

1. Describe the concepts of Business Intelligence and data warehouse.
2. Build business Data Warehouse.
3. Evaluate data mining process and Association analysis.

| Syllabus | | Total 60 L |
|---|---|---|
| **Unit I** | **Introduction to Business Intelligence and Business Data Warehouse:**<br>Operational and Decision Support System, Data-Information-Knowledge- Decision making-Action cycle. Basic definitions-Business Intelligence; Data warehousing, Business Intelligence architecture, Use and benefits of Business Intelligence. Knowledge Discovery in Databases: KDD process model, Data Pre-processing: Cleaning: Missing Values; Noisy Values; Inconsistent values; redundant values. Outliers, Integration, transformation, reduction, Discretization: Equal Width Binning; Equal Depth Binning, Normalization, Smoothing | **15 L** |
| **Unit II** | **Designing Business Data Warehouse:** Definition of Data warehouse, Logical architecture of Data Warehouse, Data Warehouse model- Enterprise warehouse; Data Marts; Virtual warehouse. Populating business Data Warehousing: data integration and extract, transform, load (ETL). | **15 L** |
| **Unit III** | OLTP and OLAP systems, Designing business information warehouse: Principles of dimensional modeling, Data cubes, Data cube operations, data cube schemas | **15 L** |
| **Unit IV** | **Introduction to Data Mining:**<br>Data mining definitions and process: business and data understanding. Association Analysis: Definition of association rule, General issues: Support; Confidence; Lift; Conviction, Frequent Item sets: APriori Algorithm; Issues with APriori Algorithm, Data structures: Hash tree and FP tree. | **15 L** |

**Text books:**

- Business Intelligence (2nd Edition), Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Pearson (2013)
- Business Intelligence for Dummies, Swain Scheps, Wiley Publications (2008).
- Building the Data Warehouse, Inmon: Wiley (1993).
- Data Mining: Introductory and Advanced Topics, Dunham, Margaret H, Prentice Hall (2006)
- Data Mining: Practical Machine Learning Tools and Techniques,Second Edition, Witten, Ian and Eibe Frank, Morgan Kaufmann (2011)

**References:**


- Business Intelligence Road Map, Larissa T. Moss, Shaku Atr, Addison-Wesley
- Data Modeling Techniques for Data Warehousing by IBM; International Technical Support Organization, Chuck Ballard, Dirk Herreman, Don Schau, Rhonda Bell, Eunsaeng Kim, Ann Valencic:http://www.redbooks.ibm.com
- Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems, Han J. and Kamber M. Morgan Kaufmann Publishers, (2000).
- Data Mining with Microsoft SQL Server 2008, MacLennan Jamie, Tang ZhaoHui and Crivat Bogdan, Wiley India Edition (2009).


| Sr. No. | List of Practical Experiments |
|---|---|
| 1 | Demonstrate KDD process. |
| 2 | Import the legacy data from different sources such as ( Excel , SqlServer, Oracle etc.) and load in the target system. ( You can download sample database such as Adventureworks, Northwind, foodmart etc.) |
| 3 | Demonstrate data preprocessing techniques |
| 4 | Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver. |
| 5 | Create the Data staging area for the selected database. |

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| 6 | Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model. |
| 7 | Create the ETL map and setup the schedule for execution. |
| 8 | Execute the MDX queries to extract the data from the datawarehouse. |
| 9 | Import the datawarehouse data in Microsoft Excel and create the Pivot table and Pivot Chart. |
| 10 | Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis. |
| 11 | Apply the what – if Analysis for data visualization. Design and generate necessary reports based on the datawarehouse data |
| 12 | Develop an application to pre-process data imported from external sources. |
| 13 | Create association rules by considering suitable parameters. |
| 14 | Write a program in Python based on Hash Tree |
| 15 | Write a program in Python based on FP Tree |

The BI tools such as Tableau / Power BI / BIRT / R / Excel or any other can be used.

| Module / Unit | Course Description | Hrs. | CO No. | PSO No. | PO No. |
|---|---|---|---|---|---|
| 1 | Introduction to Business Intelligence and Business Data Warehouse | 15h | 1,2 | 1 | 2 |
| 2 | Designing Business Data Warehouse | 15h | 3 | 2 | 5 |
| 3 | Introduction to Data Mining | 15h | 1 | 3 | 6 |

| Course Description | |
|---|---|
| **Semester** | II |
| **Course Name** | Machine Learning |
| **Course Code** | PCS2MAL |
| **Eligibility for Course** | B.Sc. |
| **Credit** | 2 |
| **Hours** | 30 |

## Course Objectives:

- To introduce key concepts of machine learning
- To conceptualize undirected graphical model for real problems

## Course Outcomes:

1. Acquire point estimation techniques for estimating parameters of machine learning models

2. Analyze advanced machine learning techniques for classification

| Syllabus | Total 30 L |
|---|---|
| **Unit I** | **Probability:**<br>A brief review of probability theory, Some common discrete distributions, Some common continuous distributions, Joint probability distributions, Transformations of random variables, Monte Carlo approximation, Information theory. Directed graphical models (Bayes nets): Introduction, Examples, Inference, Learning, Conditional independence properties of DGMs. Mixture models and EM algorithm: Latent variable models, Mixture models, Parameter estimation for mixture models, The EM algorithm. |

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| **Unit II** | **Kernels:**<br>Introduction, kernel function, Using Kernel inside GLMs, kernel trick, Support vector machines, Comparison of discriminative kernel methods.<br>Markov and hidden Markov models: Markov models, Hidden Markov Models (HMM), Inference in HMMs, Learning for HMMs. Undirected graphical models (Markov random fields): Conditional independence properties of UGMs, Parameterization of MRFs, Examples of MRFs, Learning, Conditional random fields (CRFs), applications of CRFs. |
| **Text books:** | Machine Learning: A Probabilistic Perspective: Kevin P Murphy, The MIT Press Cambridge (2012). |
| **References:** | ● Introducing Monte Carlo Methods with R, Christian P. Robert, George Casella, Springer, 2010<br>● Introduction to Machine Learning (Third Edition): Ethem Alpaydın, The MIT Press (2015).<br>● Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer (2006) |

| Sr. No. | List of Practical Experiments |
|---|---|
| 1 | Find probability density function or probability mass function, cumulative distribution function and joint distribution function to calculate probabilities and quantiles for standard statistical distributions. |
| 2 | Find cumulative distribution function and joint distribution function to calculate probabilities and quantiles for standard statistical distributions. |
| 3 | Create a Directed Acyclic Graph (DAG) using set of formulae. Find parents and children of nodes. Read conditional independence from DAG. Add and remove edges from graph. |
| 4 | Create a Directed Acyclic Graph (DAG) using set of vectors. Find parents and children of nodes. Read conditional independence from DAG. Add and remove edges from graph. |

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| 5 | Create a Directed Acyclic Graph (DAG) using set of matrices. Find parents and children of nodes. Read conditional independence from DAG. Add and remove edges from graph. |
| 6 | Create a Bayesian network for a given narrative. Set findings and ask queries [One may use narratives like ‘chest clinic narrative’ and package gRain for the purpose]. |
| 7 | Implement EM algorithm. |
| 8 | Use string kernel to find the similarity of two amino acid sequence where similarity is defined as the number of a substring in common. |
| 9 | Demonstrate SVM as a binary classifier. |
| 10 | Create a random graph and find its page rank. |
| 11 | Apply random walk technique to a multivariate time series. |
| 12 | Implement two stage Gibbs Sampler. |
| 13 | Implement Metropolis Hastings algorithm. |
| 14 | Demonstrate sampling techniques. |
| 15 | Demonstrate filtering techniques. |

| **Module /Unit** | **Course Description** | **Hrs.** | **CO No.** | **PSO No.** | **PO No.** |
|---|---|---|---|---|---|
| 1 | Probability | 15h | 1 | 1 | 1 |
| 2 | Kernels | 15h | 2 | 2 | 3 |

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