# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

## Vision & Mission of Department

**Vision**

To achieve technical & research excellence in the field of Computer Science and Engineering with industrial & social perspective.

**Mission**

- To provide environment for imparting high quality technical education, skill development, research and development.
- To disseminate sound knowledge of recent Computer Technologies by organizing seminar/workshops/short-term courses.
- To develop interaction and collaboration with the industry.
- To facilitate Hand-on training to the students for promoting Self-Employment.

## Program Outcomes (POs)

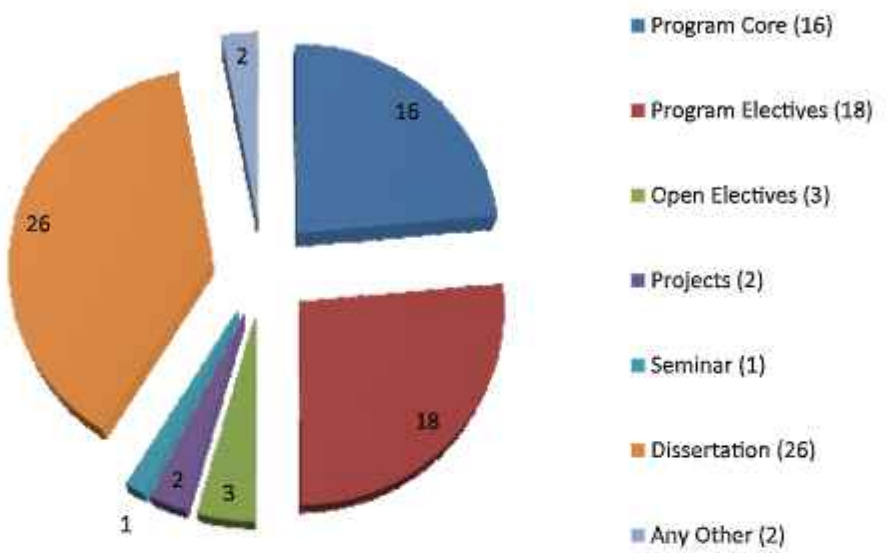
1. **Scholarship of Knowledge:** Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse, and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
2. **Critical Thinking:** Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3. **Problem Solving:** Think laterally and originally, conceptualise, and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal, and environmental factors in the core areas of expertise.
4. **Research Skill:** Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse, and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5. **Usage of modern tools:** Create, select, learn, 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. **Collaborative and Multidisciplinary work:** Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity, and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

8. **Communication:** Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9. **Life-long Learning:** Recognise the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10. **Ethical Practices and Social Responsibility:** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11. **Independent and Reflective Learning:** Observe and examine critically the outcomes of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

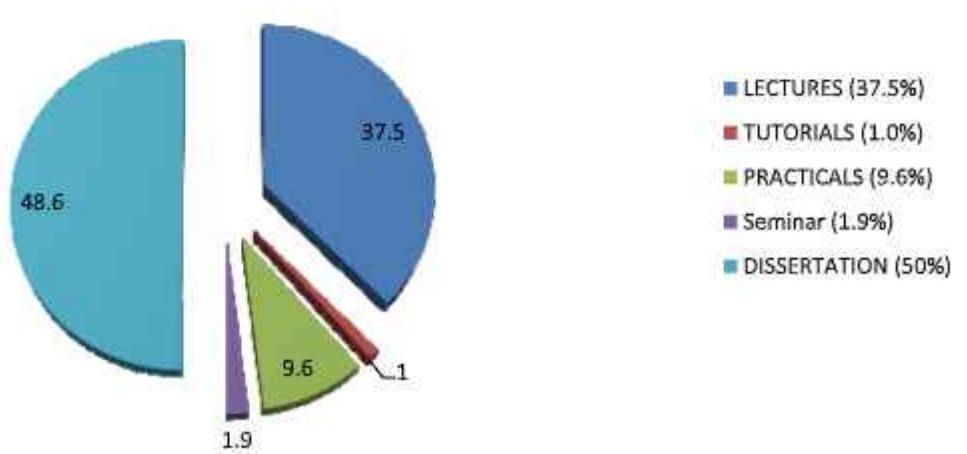
## Program Specific Outcomes (PSOs)

1) **Program Specific Outcome (PSO) 1:** The ability to take up higher studies, research, and development in modern computing environment.
2) **Program Specific Outcome (PSO) 2:** The ability to apply mathematical foundation, algorithmic principles, comprehend the technical advancements, and use research based knowledge for modelling and simulation of the problems.

# DISTRIBUTION OF COURSE CREDITS (PG)




# CONTACT HOURS DISTRIBUTION (PG)



# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

### Study Scheme PG Programme: M.Tech . in Computer Science and Engineering

| Semester-I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PCCS-811 | Artificial Intelligence | 3 | 0 | 0 | 3 | 3 |
| 2 | PCCS-812 | Operating System Design | 3 | 0 | 0 | 3 | 3 |
| 3 | PECS-811 | Core Elective-I | 3 | 0 | 0 | 3 | 3 |
| 4 | PECS-812 | Core Elective-II | 3 | 0 | 0 | 3 | 3 |
| 5 | RMAL-811 | Research Methodology and IPR | 2 | 0 | 0 | 2 | 2 |
| 6 | ACMH-811 | English research paper writing & Professional Communication | 2 | 0 | 0 | 2 | 0 |
| 7 | PCCS-813 | Artificial Intelligence Lab | 0 | 0 | 4 | 4 | 2 |
| 8 | PECS-813 | Core Elective-I Lab | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **16** | **0** | **8** | **24** | **18** |

| Semester-II (A) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PCCS-821 | Machine Learning | 3 | 1 | 0 | 4 | 4 |
| 2 | PCCS-822 | Advanced Network Principles and Protocols | 3 | 0 | 0 | 3 | 3 |
| 3 | PCCS-823 | Cyber Security | 3 | 0 | 0 | 3 | 3 |
| 4 | PECS-821 | Core Elective-III | 3 | 0 | 0 | 3 | 3 |
| 5 | PECS-822 | Core Elective-IV | 3 | 0 | 0 | 3 | 3 |
| 6 | ACMH-821 | Constitution Of India | 2 | 0 | 0 | 2 | 0 |
| 7 | PECS-823 | Core Elective-IV Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | PCCS-824 | Seminar | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **17** | **1** | **4** | **22** | **18** |

**Students are to be encouraged to go to industrial training/ Internship during summer break**

| Semester-III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PECS-911 | Core Elective-V | 3 | 0 | 0 | 3 | 3 |
| 2 | OECS-911 | Open Elective | 3 | 0 | 0 | 3 | 3 |
| 3 | PCCS-911 | Dissertation (Part-1) | 0 | 0 | 20 | 20 | 10 |
| | | **Total** | **6** | **0** | **20** | **26** | **16** |

| Semester-IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PCCS-921 | Dissertation (Part-2) | 0 | 0 | 32 | 32 | 16 |
| | | **Total** | **0** | **0** | **32** | **32** | **16** |

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

### List of Core Electives

| CORE ELECTIVE I (PECS-811) | | |
|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-811A | Parallel Computing |
| 2 | PECS-811B | Data Preparation and Analysis |
| 3 | PECS-811C | Advance Database Systems |
| **CORE ELECTIVE I LAB(PECS-813)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-813A | Parallel Computing Lab |
| 2 | PECS-813B | Data Preparation and Analysis Lab |
| 3 | PECS-813C | Advance Database Systems Lab |
| **CORE ELECTIVE II (PECS-812)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-812A | Distributed Systems |
| 2 | PECS-812B | Advance Algorithms |
| 3 | PECS-812C | Big Data Analytics |
| **CORE ELECTIVE III (PECS-821)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-821A | Deep Learning |
| 2 | PECS-821B | Software Project Management |
| 3 | PECS-821C | Computer Vision |
| **CORE ELECTIVE IV (PECS-822)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-822A | Cloud Computing |
| 2 | PECS-822B | Internet of Things |
| 3 | PECS-822C | Bioinformatics |
| **CORE ELECTIVE IV LAB (PECS-823)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-823A | Cloud Computing Lab |
| 2 | PECS-823B | Internet of Things Lab |
| 3 | PECS-823C | Bioinformatics Lab |
| **CORE ELECTIVE V (PECS-911)** | | |
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | PECS-911A | Optimization Techniques |
| 2 | PECS-911B | Pattern Recognition |
| 3 | PECS-911C | Data Sciences |

### List of Open Electives

| OPEN ELECTIVE | | |
|---|---|---|
| **Sr. No.** | **Subject Code** | **Subject Name** |
| 1 | OECS-911A | Big Data Analytics |
| 2 | OECS-911B | Internet of Things |
| 3 | OECS-911C | Deep Learning |
| 4 | OECS-911D | Cloud Computing |
| 5 | OECS-911E | Cyber Security |

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Artificial Intelligence**
**Subject Code** : **PCCS-811**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | Understanding the basics of AI and various applications of AI. |
| CO2 | Problem Solving using Search and Control strategies. |
| CO3 | Understanding the knowledge representation and reasoning |
| CO4 | Understanding the basics of Expert Systems, Neural Networks and Genetic Algorithms |
| CO5 | Understanding the basics of Planning, Understanding and Learning and Common sense |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO5 | 1 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 1 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 1. Introduction | Definitions, Goals of AI, AI Approaches, AI Techniques, AI application Areas | 06 |
| | 2. Problem solving | General problem solving, Search and control strategies, Exhaustive searches, Heuristic search techniques, Constraint satisfaction problems (CSPs), models. Heuristic Search of Game trees, Problem Reduction (AND/OR Search). | 09 |
| | 3. Knowledge representation and reasoning | Knowledge representation, KR using predicate logic, representing instance and Isa relationship, computable functions and predicates, Resolution, Natural Deduction, representing knowledge using rules, Weak Slot and Filler Structure, Strong slot and Filler structure | 09 |
| Unit-2 | 4. Advanced Reasoning and learning | Non-monotonic reasoning, Logics for non-monotic reasoning, Augmenting a problem solver, Bayes Theorem, Bayesian networks, reasoning with Bayes network, Decision Tree | 09 |
| | 5. Expert Systems, Neural Networks, GA | Introduction to Expert Systems, Expert System Architecture, Introduction to neural network and learning, Introduction to Genetic algorithms, operators. | 09 |

| | | | |
|---|---|---|---|
| | 6. Advance AI topics | Introduction to Planning, Understanding, Learning, Common Sense | 06 |

Total=48

**Recommended Books:**

1. Rich E, K. Knight, "Artificial Intelligence", Tata McGr aw Hill.
2. George F. Luger, "Artificial Intelligence – Structures and Strategies for Complex Problem Solving", Pearson Education.
3. Russell, Norvig, "Artificial Intelligence 'a Modern Approach", Pearson Education.
4. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI.
5. E. Charnaik, D. McDermott, "Introduction to Artificial Intelligence", Addison-Wesley Publishing Company.
6. Christopher Thronton, Benedict du Bouldy,"Artificial Intelligence", New Age International Publishers.
7. Nils J. Nilsson, "Principles of Artificial Intelligence", Narosa Publishing Co.
8. Ela Kumar "Artificial Intelligence", I.K International Publishing House.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Operating System Design**
**Subject Code** : **PCCS-812**
**Weekly load** : **3 Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Acquire the basic understanding of OS functionality. |
| CO2 | Understand the role of OS in process management. |
| CO3 | Comprehensive knowledge of data storage management by OS |
| CO4 | Implement file management strategies |
| CO5 | In depth knowledge of different types of OS environments. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Structure of Operating System | Monolithic, Microkernel, Multi Kernel, Services and components, OS design issues. | 06 |
| | 2. Process Management | The process and the kernel Mode, Process abstraction, Threads, Process Synchronization, Semaphores, Monitors, Inter Process Communication, Schedulers, CPU Scheduling. | 10 |
| | 3. Memory and Input Output Management | Memory management, Virtual memory, Demand Paging and Page Replacement Algorithms, I/O and Device management, buffering and spooling. | 08 |
| **Unit-2** | 4. File Management | The user interface to Files, File systems, Special files, File system framework, File storage, Access methods and free space management. | 08 |
| | 5. Deadlocks and Operating System Security | Deadlocks, External & Operational security, Access control, H/W security. | 08 |
| | 6. Distributed Operating Systems | Architectures, Synchronization, Communication, Resource Management, Distributed File Systems, Distributed Shared Memory, Code migration and Distributed Scheduling, Recovery and Fault Tolerance. | 08 |

**Total=48**

**Recommended Books:**


1. Abraham Silberschatz, Peter Baer Galvin, "Operating System Concepts", Addison - Wesley.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education.
3. H.M. Deitel, "An Introduction to Operating System", Pearson Education.
4. William Stallings, "Operating Systems", Pearson Education.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Parallel Computing**
**Subject Code** : **PECS-811A**
**Weekly load** : **3 Hrs** **LTP 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Understand the concepts related to parallel computing |
| CO2 | Learn how to measure the performance of parallel computers |
| CO3 | Understand the advanced processor technology and memory hierarchy |
| CO4 | Acquire knowledge of memory organization |
| CO5 | Learn the concepts behind multithreaded architecture and multi-core programming |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Parallel Computer Models | The State of Computing, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, Architectural Development Tracks. | 06 |
| | 2. Program and Network Properties | Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architecture. | 06 |
| | 3. Metrics and Scalability | Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches. | 06 |
| | 4. Processor Hierarchy | Advanced Processor Technology, Superscalar and Vector Processors. | 06 |
| **Unit-2** | 5. Memory Hierarchy | Memory Hierarchy Technology, Virtual Memory Technology. | 06 |
| | 6. Bus, Cache, and Shared Memory | Bus Systems, Cache Memory Organizations, Shared-Memory Organizations, Sequential and Weak Consistency Models, Cache Coherence and Synchronization Mechanisms, Message-Passing Mechanisms. | 06 |

| | | | |
|---|---|---|---|
| | 7. Pipelining and Superscalar Techniques and Multivector Computers | Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design, Superscalar Pipeline Design, Vector Processing Principles, Compound Vector Processing, Latency-Hiding Techniques. | 06 |
| | 8. Principles of Multithreading | Threads Versus Processes, Types of Thread-Level Parallelism: Chip-Level Multiprocessing, Interleaved Multithreading, Simultaneous Multithreading, Hyper threading. | 06 |

**Total=48**

**Recommended Books:**

1. Kai Hwang, Advanced Computer Architecture, McGraw-Hill.
2. Kai Hwang, F Briggs, Computer Architecture and Parallel Processing, McGraw Hill.
3. M Flynn, Computer Architecture: Pipelined and Parallel Processor Design, 1/E, Jones and Bartlett.
4. Harry F Jordan, Fundamentals of Parallel Processing, Prentice Hall.
5. Hesham El-Rewini, Mostafa Abd-El-Barr, Advanced Computer Architecture and Parallel Processing, Wiley-Interscience.
6. Shameem Akhter, Jason Roberts, Multi-Core Programming, Intel Press.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Data Preparation and Analysis**
**Subject Code** : **PECS-811B**
**Weekly load** : **3Hrs** **LTP 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Acquire knowledge of data gathering strategies |
| CO2 | Prepare and Present the Data |
| CO3 | Extract the data for performing the Analysis |
| CO4 | Understand Data Clustering and association |
| CO5 | Design visualization and time series |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Data Gathering and Preparation | Data formats, parsing and transformation, Scalability and real-time issues. | 09 |
| | 2. Data Cleaning | Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation. | 11 |
| **Unit-2** | 3. Exploratory Analysis | Descriptive and comparative statistics, Clustering and association, Hypothesis generation. | 13 |
| | 4. Visualization | Designing visualizations, Time series, Gelocated data, Correlations and connections, Hierarchies and network interactivity. | 15 |

**Total = 48**

**Reference Books:**

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Advance Database Systems**
Subject Code : **PECS-811C**
Weekly load : **3 Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | To understand the basic concepts and terminology related to DBMS and Relational Database Design |
| CO2 | To the design and implement Distributed and Parallel Databases |
| CO3 | Demonstrate the knowledge of Object Oriented Databases |
| CO4 | To understand the concept of Transaction Management in the Database |
| CO5 | Understanding the concept of Emerging and Internet Database Technologies |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Database System Concepts and Architecture, Data Independence, Data Models, SQL: DDL, DML, DCL, Database Integrity, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF. | 06 |
| | 2. Advanced Transaction Processing and Concurrency Control | Transaction Concepts, Concurrency Control: Locking Methods, Time-stamping Methods, Optimistic Methods for Concurrency Control, Concurrency Control in Distributed Systems | 06 |
| | 3. Object Oriented and Object Relational Databases | Object Oriented Concepts with respect to Database Systems, OODBMS, OORDBMS, ORDBMS Design, Mapping of classes to relations, OORDBMS Query Language | 04 |

| | | | |
|---|---|---|---|
| | 4. Parallel Databases | Parallel Databases, Distributed Databases, Difference between them, Architecture of Distributed Databases, Architecture of Parallel Databases | 04 |
| | 5. Distributed Databases | Fragmentation, Replication and Allocation for distributed databases, Intra-query parallelism, Inter-query parallelism, Intra-operation parallelism, Inter-operation parallelism. | 04 |
| Unit2 | 6. Database Security and Integrity | Data security risks, Data user, Access control and encryption. | 02 |
| | 7. Backup and Recovery Techniques | Backup and Recovery Concepts, Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management, Recovery Control in Distributed Systems. | 08 |
| | 8. Introduction to Pl/SQL | Procedure, trigger and cursor | 02 |
| | 9. XML and Internet Databases | Structured, Semi Structured, and Unstructured Data, XML Hierarchical Data Model, XML Documents, DTD, XML Schema, XML Querying: XPath, XQuery | 04 |
| | 10. Emerging Database Technologies | Introduction to Mobile Databases, Main Memory Databases, Deductive Database Systems and brief overview of Datalog, Temporal Databases and brief introduction to TSQL, Multimedia Databases brief overview of respective query language and Spatial and Multidimensional Databases,Brief Introduction to Data Warehouse, Data Mining and OLAP | 08 |

**Total=48**

**Recommended Books:**

1. Raghu Ramakrishnan, Johannes Gehrke, "Database Management System", McGraw Hill.
2. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database System", Pearson Education.
3. G.W. Hansen, J.V. Hansen, "Database Ma nagement and Design", PHI.
4. C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Pearson Education.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Distributed Systems**
**Subject Code** : **PECS-812A**
**Weekly load** : **3Hrs.** **L T P: 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Students can implement programming projects that display knowledge of a variety of distributed system architectural styles. Some of these assignments represent significant programming projects with wide leeway in design and implementation choices. |
| CO2 | Students will analyze problems, determine solutions within an assigned architectural style, and successfully implement those solutions. |
| CO3 | Students will use cloud-based systems to run and implement assignments |
| CO4 | Students will design and implement projects both individually and as part of a team. |
| CO5 | Students will manage a cloud-based Web server and properly configure it. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction to Distributed Systems | Definition of distributed systems, their objectives, types, hardware and software concepts, architecture. | 06 |
| | 2. Web Services Concepts | Introduction to XML, SOAP, Web and Grid services concepts. | 06 |
| | 3. Communication | Inter process communication, Remote Procedure Call (RPC), Remote Method Invocation (RMI), Remote Object Invocation, and Message Oriented Communication. | 08 |
| | 4. Processes | Introduction to threads, Threads in distributed and non-distributed systems, Client side software, Design issues for Servers, Software agents. | 06 |

| | | | |
|---|---|---|---|
| **Unit-2** | 5. Naming | General issues with respect to naming, Name resolution, implementation of a name space, Domain name Systems, X.500 name space. | 06 |
| | 6. Security | Introduction to security in distributed systems, General issues in authentication and access control, Security management: Key management, secure group management, authorization management; examples: Kerberos, x.509 certificates. | 08 |
| | 7. Distributed Object-based Systems | Introduction to distributed object based systems, Overview of CORBA and DCOM and their comparison. | 04 |
| | 8. Distributed File System and Document Based Systems | Introduction to distributed file system, distributed document-based systems, their examples. | 04 |

**Total=48**

**Recommended Books:**

1. Andrew S Tanenbaum, Principles and Paradigms of Distributed Sytsems, Pearson Education.
2. George Coulouris, Distributed Systems, Addison Wesley.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Advance Algorithms**
**Subject Code** : **PECS-812B**
**Weekly load** : **3 Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Analyze worst-case running times of algorithms using asymptotic analysis. |
| CO2 | Prove the correctness of algorithms using inductive proofs and invariants. |
| CO3 | Analyze randomized algorithms with respect to expected running time |
| CO4 | Classify problems into different complexity classes correspond ing to both deterministic and randomized algorithms |
| CO5 | Analyze approximation algorithms |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Analysis of Algorithm | Algorithms, Analysing Algorithms, Growth of Functions-order Arithmetic, Models of computation, Performance analysis. | 08 |
| | 2. Elementary data Structures | Stacks and Queues, Lists, Trees, Dictionaries, sets and Graphs. | 08 |
| | 3. Basic Design Methodologies | Divide and Conquer, Dynamic Programming, Backtracking, Greedy Algorithms, Branch and bound. | 08 |
| **Unit-2** | 4.Particular Algorithms | Disjoint set manipulation, Matrix multiplication, Pattern matching, sorting and searching algorithms, combinatorial algorithms, string processing algorithms, Algebraic Algorithms, Graph Algorithms, Comparative study of sorting techniques with their complexities. | 12 |
| | 5. NP Completeness | Problem classes, NP-Completeness, Deterministic and non-Deterministic polynomial time algorithms, Theory of lower bounds Approximation Algorithms. | 12 |

**Total=48**

**Recommended Books:**

1. Thomas H. Cormen, Charles E. Leiserson, "Introduction to Algorithms", PHI.
2. Alfred V. Aho, John E. Hopcroft, "Design & Analysis of Computer Algorithms", Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, S. Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publishers.
4. Donald E. Knuth, "The Art of Programming", Pearson Education.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Big Data Analytics**
**Subject Code** : **PECS-812 C**
**Weekly load** : **3Hrs** **LTP 3 0 0**
**Credit** : **3**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | Describe big data and use cases from selected business domains |
| CO2 | Explain NoSQL big data management |
| CO3 | Install, configure, and run Hadoop and HDFS |
| CO4 | Perform map-reduce analytics using Hadoop |
| CO5 | Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 1. Introduction | Big data, need of big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics | 08 |
| | 2. NoSQL | Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations. | 08 |
| | 3. Hadoop | Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures | 08 |

| | | | |
|---|---|---|---|
| | 4. MapReduce | MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map- | 08 |
| Unit-2 | | reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats | |
| | 5. Hbase and Cassandra | Hbase, data model and implementations,Hbaseclients, Hbase examples, praxis Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration | 08 |
| | 6. High Level utilities(Pig, Grunt, Hive) | Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts, Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries. | 08 |

**Total=48**

**Recommended Books:**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brie f Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
6. E. Capriolo, D. Wampler, and J . Rutherglen, "Programming Hive", O'Reilley, 2012.
7. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
9. Alan Gates, "Programming Pig", O'Reilley, 2011.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Artificial Intelligence Lab**

Subject Code : **PCCS-813**

Weekly load : **4 Hrs** **L T P 0 0 4**

Credit : **2**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | Understanding the basics of AI and Prolog programming. |
| CO2 | Implement DFS, BFS and TSP |
| CO3 | Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing |
| CO4 | Solve complex puzzles |
| CO5 | Understanding the implementation and architecture of Expert Syste m. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

Introduction to prolog programming, Implementing DFS, BFS, TSP, simulated annealing, hill climbing, Hanoi problem, 8-puzzle problem and A* algorithm using Prolog, Implementation of Expert System with forward chaining using JESS/ CLIPS. Implementation Expert System with backward chaining using RVD/PROLOG

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Parallel Computing Lab**

Subject Code : **PECS-813A**

Weekly load : **4 Hrs** LTP: 0 0 4

Credits : **2**

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

| | |
|---|---|
| CO1 | Gain practical skills in development of parallel programs |
| CO2 | Use OpenMP and MPI technologies for development of parallel programs for computing systems with shared and distributed memory |
| CO3 | Run simulation experiments on high-performance computing systems |
| CO4 | Perform parallel calculations efficiency assessment |
| CO5 | Use multithreading programming to implement programs |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

### LIST OF PRACTICALS

Introduction to OpenMP, Parallelizing a Simple Loop using OpenMP, Creating threads in OpenMP, Demonstrate thread synchronization in OpenMP, Demonstration of the clause used in the data environment, Create a program that computes a simple matrix vector multiplication b=Ax, in C/C++, Use OpenMP directives to make it run in parallel, Create a program that computes the sum of all the elements in an array A (in C/C++), Use OpenMP directives to make it run in parallel, Create a program that finds the largest number in an array A (in C/C++), Use OpenMP directives to make it run in parallel.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Data Preparation and Analysis Lab**

Subject Code : **PECS-813B**

Weekly load : **4 Hrs** LTP 0 0 4

Credit : **2**

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

| | |
|---|---|
| CO1 | Understand various data formats and their transformation |
| CO2 | Association and clustering of data |
| CO3 | Find meaning full visualization of data |
| CO4 | Use hypothesis generation on data |
| CO5 | Implement consistency checking and find missing data |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

In this lab students are required to implement and understand the various Data Formats and Various Software Tools to transform these data formats, consistency checking, missing data, comparative statistics, Clustering and association of data, hypothesis generatio n on data and meaning full visualization of data.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Advance Database System Lab**

Subject Code : **PECS-813 C**

Weekly load : **4Hrs** LTP 0 0 4

Credit : **2**

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

| | |
|---|---|
| CO1 | Acquire knowledge of advance database system. |
| CO2 | To learn different software used for advance database system. |
| CO3 | In depth knowledge of different techniques and tools used in advance database system. |
| CO4 | Learn about various formats of databases |
| CO5 | Implement various application based on different databases |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |

In this lab the students are required to implement the applications based on Relational databases, Object-oriented databases and Distributed databases.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Machine Learning**
Subject Code : **PCCS-821**
Weekly load : **4 Hrs** **L T P 3 1 0**
Credit : **4**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | Understand the basics of Machine Learning, Data Preparation and Modelling, Regression and Classification |
| CO2 | Understanding Bayesian Learning |
| CO3 | Understanding Decision tree Learning |
| CO4 | Understanding ANN, Instance based learning and clustering |
| CO5 | Understanding Ensemble Learning Methods |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Motivation, Introduction to machine learning, types of machine learning, Regression and Classification, Exploring Data for modelling, Selection and evaluation of Model, Feature Engineering | 07 |
| | 2. Decision Tree and Bayesian Learning | Decision Tree representation, appropriate problems for tree learning, Univariate Trees(Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. | 10 |
| | 3. Bayesian Learning | Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naïve Bayes Classifier, Bayesian belief networks, The EM algorithm | 07 |
| **Unit-2** | 4. ANN Learning | Neural Network, Perceptron, Multilayer Neural Network, Back-propagation, Recurrent Network, SVM, Introduction to Deep Learning | 08 |
| | 5. Instance Based Learning and Clustering | K-Nearest Neighbor Learning, Introduction to clustering, k-means clustering, agglomerative hierarchical clustering | 08 |

| | | | |
|---|---|---|---|
| | 6. Ensemble Learning Methods | Introduction to Ensemble Learning, Bagging, Boosting | 08 |

**Total=48**

**Recommended Books:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The E lements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. SakatDutt, S Chandramouli,Amit Kumar Das :Machine Learning, Pearson , 2018
5. Mitchell T.M , Machine Learning, McGraw Hill , 1997
6. Alpaydin E, Introduction to Machine Learning, MIT Press , 2010
7. Bishop C, Pattern Recognition and Machine Learning, Springer Verlag (2006)

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Advanced Network Principles and Protocols**
Subject Code : **PCCS-822**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | Learn basic understanding of the layered protocol models. |
| CO2 | Get a comprehensive practical knowledge of peer to peer and end to end communication. |
| CO3 | Acquire in depth knowledge of Internetwork routing of data. |
| CO4 | Learn working of various network protocols |
| CO5 | Apply knowledge of networking technologies to design a network as per the organization requirements. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Data and Media | Theoretical Basis of Data Communication, Data Rate, Transmission Media, Wireless Transmission, WDM system, Optical LANs, Optical paths and networks | 08 |
| | 2. Review of Networking Concepts | Reference Models, MAC layer issues, Network Technologies, ARP/RARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR. | 08 |
| | 3. Routing of Data | Internetworking, IP protocol, IP header, Internet Multicasting, Mobile IP, IPv6, Routing architecture, Routing Algorithms, Congestion Control Algorithms. | 08 |
| **Unit-2** | 4. End to End Protocols | TCP connection establishment and termination, Sliding window concepts, other issues: wraparound, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. Congestion and flow control, Queuing theory, Transport protocol for real time (RTP), Quality of service: Integrated Services, Differentiated services, UDP. | 12 |

| | | | |
|---|---|---|---|
| | 5. Shared Communications Protocols and Interface | Domain Name System, Simple Mail Transfer Protocol, File Transfer Protocol, Post Office Protocol, Hyper Text Transfer Protocol | 06 |
| | 6. Emerging Trends in Networking | Zigbee Protocol, Wireless Sensor Networks, Internet of Things | 06 |

**Total=48**

**Recommended Books:**

1. Andrew S. Tanenbaum, "Computer Networks", PHI.
2. A. Behrouz Forouzan, "Data Communication and Networking", TMH.
3. William Stalling, "Data and Computer Communication", Pearson Education.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Cyber Security**
Subject Code : **PCCS-823**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | Understand the basic terminologies related to cyber security. |
| CO2 | Acquire knowledge about the type and nature of cyber crimes and as to how report these crimes through the prescribed legal and Government channels. |
| CO3 | Understand the legal framework that exists in India for cyber crimes and penalties and punishments for such crimes. |
| CO4 | Understand the aspects related to personal data privacy and security. |
| CO5 | Get insights into risk based assessment, requirement of security controls. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 1. Overview of Cyber security | Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies. | 10 |
| | 2. Cyber crimes | Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies. | 14 |

| | | | |
|---|---|---|---|
| Unit-2 | 3. Cyber Law | Cyber crime and legal landscape around the world, IT Act,2000 and its amendments and limitation. Cyber crime and punishments, Cyber Laws, Legal and Ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies. | 08 |
| | 4. Data Privacy and Security | Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues. | 08 |
| | 5. Cyber security Management Compliance and Framework | Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy. NIST Framework, MITRE Attack TTP's | 08 |

**Total=48**

**Recommended Books:**

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1stEdition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Deep learning**
Subject Code : **PECS-821A**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | Learn the development and application of modern neural networks. |
| CO2 | Be able to build, train and apply fully connected deep neural networks |
| CO3 | Know how to implement efficient (vectorized) neural networks |
| CO4 | Understand the key parameters in a neural network's archite cture |
| CO5 | Understand how to build a convolutional neural network, including recent variations such as residual networks. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit1** | 1. Introduction | What is a neural network? Supervised Learning with Neural Networks, Why is Deep Learning taking off?<br>Neural network Basics: Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Gradient Descent on m Examples<br>Shallow Neural Networks: Neural Networks Overview, Neural Network Representation, Computing a Neural Network's Output, Vectorizing across multiple examples, Explanation for Vectorized Implementation, Activation functions, Why do you need non-linear activation functions?, Derivatives of activation functions, Gradient descent for Neural Networks, Back-propagation algorithm, | 08 |
| | 2. Deep neural networks | Deep L-layer neural network, Forward Propagation in a Deep Network, Getting your matrix dimensions right, Why deep representations?, Building blocks of deep neural networks, Forward and Backward Propagation, Param eters vs Hyper-parameters.<br>Practical aspects of deep learning: Train/Dev/Test sets, Bias/ Variance, Regularization, Why regularization reduces | 08 |

| | | | |
|---|---|---|---|
| | | over fitting?, Dropout Regularization, Understanding Dropout, Other regularization methods, Normalizing inputs, Vanishing / Exploding gradients, Weight Initialization for Deep Networks, Numerical approximation of gradients, Gradient checking | |
| | 3. Optimization algorithms | Mini-batch gradient descent, Understanding mini-batch gradient descent, Exponentially weighted averages, Understanding exponentially weighted averages, Bias correction in exponentially weighted averages, Gradient descent with momentum, RMSprop, Adam optimization algorithm, Learning rate decay, The problem of local optima | 08 |
| **Unit-2** | 4. Hyper parameter tuning, Batch Normalization and Programming Frameworks | Tuning process, Using an appropriate scale to pick hyper parameters, Hyper parameters tuning in practice: Pandas vs. Caviar, Normalizing activations in a network, Fitting Batch Norm into a neural network, Why does Batch Norm work?, Batch Norm at test time, Softmax Regression, Training a softmax classifier, Deep learning frameworks, Tensor-Flow. | 08 |
| | 5. Convolutional Neural Networks | Foundations of Convolutional Neural Networks: Computer Vision, Edge Detection Example, More Edge Detection, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, CNN Example, Why Convolutions?<br>Deep convolutional models: case studies, Why look at case studies?, Classic Networks, ResNets, Why ResNets Work, Networks in Networks and 1x1 Convolutions, Inception Network Motivation, Inception Network, Transfer Learning, Data Augmentation | 08 |
| | 6. Sequence Models | Recurrent Neural Networks: Why sequence models, Notation, Recurrent Neural Network Model, Back-propagation through time, Different types of RNNs, Language model and sequence generation, Sampling novel sequences, Vanishing gradients with RNNs, Gated Recurrent Unit (GRU),Long Short Term Memory (LSTM),Bidirectional RNN, Deep RNNs. | 08 |

**Total=48**

**Recommended Books:**

The required textbook for the course is

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning.

Other recommended supplemental textbooks on general machine learning:

2. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification . Wiley-Interscience. 2nd Edition. 2001.
3. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4 . Academic Press, 2008.
4. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
5. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
6. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning, Springer. 2001.
7. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Software Project Management**
**Subject Code** : **PECS-821B**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Comprehend software project management activities |
| CO2 | Understand various steps required for project planning |
| CO3 | Create an estimation and effective cost benefit evaluation techniques |
| CO4 | Design framework for risk management |
| CO5 | Comprehend resource management |

| Cos | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Introduction to software project management, types of project, project attributes, project constraints, importance of management, problems with software projects, management control, role of project manager, steps in project planning, Programme management, managing resources within Programme, | 12 |
| | 2. Software Cost and Time Estimation | A system view of project management, stakeholder management, Assessment of projects, Cost-benefit Analysis, Cash flow forecasting, Cost-benefit evaluation techniques, Selection of an appropriate project technology, Choice of process model, developing the project schedule, Estimation Techniques, Problem with over and underestimates, COCOMO Model | 12 |
| **Unit-2** | 3. Planning | Objective of Planning, Project Schedule, Activities – Sequencing and Scheduling, Development of Project Network, Time Estimation, Forward and backward Pass, Critical Path and Activities. Introduction to project risk management, Risk categories, identification, assessment, planning, management, Software Configuration | 12 |

| | | | |
|---|---|---|---|
| | | Management Process: Version Control, Change Control management, PERT and CPM Models, project implementation | |
| | 4. Software Project Management | Resources, Nature of Resources, developing the project budget, monitoring and controlling the project, project metrics, Project targets, Management Spectrum, Associating human resource with job, Motivation, Oldham- job Characteristics Model, Decision Making, Leadership, Stress Management, Health and Safety | 12 |

**Total=48**

**Recommended Books:**

1. Bob Hughes, Mike Cotterell, "Software Project Management", Tata McGraw Hill.
2. Prasanna Chandra, "Projects: Panning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill Publication.
3. Jeffrey K. Pinto, "Project Management", Pearson Publications.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Computer Vision**
Subject Code : **PECS-821C**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | To learn the basics of sensor and imaging. |
| CO2 | To study about the signal representation and non linear image processing |
| CO3 | Analyze the feature estimation in image processing techniques. |
| CO4 | To study the image and video compression standards. |
| CO5 | Understand analysis and classification of objects |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Sensor and Imaging: Imaging Optics, Radiometry of Imaging, Illumination sources and techniques, Camera Principles, Color Imaging, Single Sensor Color Imaging and Color Demosaicing, Range Images, 3D Imaging. | 6 |
| | 2. Signal Representation | Vector Space and Unitary Trasnsforms, Multi-Resolutional Signal Representation, Wavelet Decomposition, Scale space and diffusion, Representation of color, Retinex Processing, Markov Random Field Modellings of Images. | 8 |
| | 3. Non-linear Image Processing | Median and Order Statistics Filters, Rank-Ordered-Mean Filters and Signal Dependent Rank-Ordered-Mean Filters, Two Dimensional Teager Filters, Applications of nonlinear filters in image enhancement, edge detections, noise removal etc. | 8 |
| **Unit-2** | 4. Feature Estimation | Morphological Operations, Edge Detection, Edges in multichannel images, Texture Analysis, Optical flow based motion estimation, Reflectance based shape recovery, Depth from focus, Stereo matching and depth estimation. | 6 |
| | 5. Image and Video Compression Standards | Lossy and lossless compression schemes: Transform Based, Sub-band Decomposition, Entropy Encoding, JPEG, JPEG2000, MPEG-1, MPEG-4, and MPEG-7. | 8 |
| | 6. Object Analysis, Classification | Bayesian Classification, Fuzzy Classification, Neural Network Classifiers, Shape Reconstruction from volumetric data, Knowledge-based interpretation of images. | 5 |

**Recommended Books:**


1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Cloud Computing**
Subject Code : **PECS-822A**
Weekly load : **3Hrs** LTP 3 0 0
Credit : **3**

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

| | |
|---|---|
| CO1 | To create a brief understanding of cloud computing and other related technologies (Grid/cluster etc.). |
| CO2 | To understand cloud service models, deployment models and service inception through virtualization in cloud. |
| CO3 | To understand various security issues in cloud as well as an overview of the basic architectures of cloud computing. |
| CO4 | To understand the architecture of cloud computing up to an advance stage |
| CO5 | To understand the considerations of cloud delivery models this includes an introduction to data center and working with IaaS, PaaS and SaaS. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Understanding Cloud Computing | Origins and Influences: A Brief History, Clustering, Grid Computing, Virtualization, Technology Innovations vs. Enabling Technologies. Basic Concepts and Terminology :Cloud, IT Resource, On-Premise, Cloud Consumers and Cloud Providers, Scaling (Horizontal/Vertical), Cloud Service, Service Consumer Goals and Benefits, Risks and Challenges, Cloud Provider, Cloud Consumer, Cloud Service Owner, Cloud Resource Administrator, Organizational Boundary, Trust Boundary. | 06 |
| | 2. Service deployment Models and Virtualization | Cloud Characteristics, Cloud Service Delivery Models: IaaS, PaaS, SaaS, Deployment Models: Public Clouds, Community Clouds, Private Clouds, Hybrid Clouds. Virtualization Technology: Hardware Independence, Server Consolidation, Operating System-Based Virtualization, Hardware-Based Virtualization, Virtualization Management. | 06 |

| | | | |
|---|---|---|---|
| | 3. Cloud Security | Basic Terms and Concepts- Confidentiality, Integrity, Authenticity, Availability, Threat, Vulnerability, Risk, Security Controls, Security Mechanisms, Security Policies, Threat Agents- Anonymous Attacker, Malicious Service Agent, Trusted Attacker, Malicious Insider, Cloud Security Threats- Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Insufficient Authorization, Virtualization Attack. | 06 |
| | 4. Cloud Computing Architecture | Fundamental Cloud Architectures- Architecture of Workload Distribution, Resource Pooling, Dynamic Scalability, Elastic Resource Capacity, Service Load Balancing, Cloud Bursting, Elastic Disk Provisioning, Redundant Storage | 06 |
| **Unit-2** | 5. Advance cloud computing architecture | Hypervisor Clustering, Load Balanced Virtual Server Instances, Non-Disruptive Service Relocation, Zero Downtime, Cloud Balancing, Resource Reservation, Dynamic Failure Detection and Recovery, Bare -Metal Provisioning, Rapid Provisioning Architecture, Storage Workload Management | 06 |
| | 6. Cloud Delivery Model Considerations | Building IaaS Environments, Data Centers, Equipping PaaS Environments, Optimizing SaaS Environments, Cloud Delivery Models: The Cloud ConsumerPerspective, Working with IaaS Environments, Working with PaaS Environments ,Working with SaaS Services | 06 |
| | 7. Case study | Case study of a Cloud Management and Virtualization software for example Eucalyptus, VMware etc. | 12 |

**Total=48**

**Recommended Books:**

1. Thomas Erl, Zaigham Mahmood, RicardoPuttini, "Cloud Computing: Concepts, Technology and Architecture", Prentice Hall.
2. John W. Rittinghouse, James F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press.
3. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC.
4. Bunker, Darren Thomson, "Delivering Utility Computing",John Wiley and Sons Ltd.
5. George Reese, "Cloud Application Architectures", O'reilly Publications.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Internet of Things**
**Subject Code** : **PECS-822B**
**Weekly load** : **3Hrs** **L T P: 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Understand the application areas of IOT |
| CO2 | Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks |
| CO3 | Acquire knowledge of characteristics of different types of sensors used in IoT |
| CO3 | Analyze randomized algorithms with respect to expected running time |
| CO4 | Understand building blocks of Internet of Things and characteristics |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT. Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security | 08 |
| | 2. Sensors | Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc | 08 |
| | 3. Characteristics of Sensors | Important Characteristics of Sensors: Determination of the Characteristics: Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality | 08 |

| | | | |
|---|---|---|---|
| | | Impedance Spectroscopy: Equivalent circuit of Sensors and Modeling of Sensors, Importance and Adoption of Smart Sensors. | |
| **Unit-2** | 4. Architecture and Design constraints | IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.Real-World Design Constraints- Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote controlArchitecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical. Vapor, Anodization, Sol-gel | 8 |
| | 5. Hardware Platforms and Physical Devices for IOT | Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry , Interface and Programming & IOT Device | 8 |
| | 6. Recent Trends | Recent trends in smart sensor for day to day life, evolving sensors, their architecture and IOT architecture, Automation in Industrial aspect of IOT | 8 |

**Total=48**

**Recommended Books:**


- John Vince, Foundation Mathematics for Computer Science, Springer.
- K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications.
- Wiley. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
- Alan Tucker, Applied Combinatorics, Wiley Donald E. Knuth, "The Art of Programming", Pearson Education
- Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Bioinformatics**
Subject Code : **PECS-822C**
Weekly load : **3 Hrs** L T P 3 0 0
Credit : **3**

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

| | |
|---|---|
| CO1 | Acquire the basic understanding of bioinformatics. |
| CO2 | Understand the role of bioinformatics in real life. |
| CO3 | Comprehensive knowledge of various datasets of bioinformatics. |
| CO4 | Understand the concept of Phylogeny |
| CO5 | In depth knowledge of techniques and tools used in bioinformatics. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction and Bioinformatics Resources | Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases:<br>• Nucleic acid sequence databases-GenBank, EMBL, DDBJ.<br>• Protein sequence databases- SWISS-PROT, TrEMBL, PIR, PDB.<br>• Genome Databases - NCBI, EBI, TIGR, SANGER.<br>• Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources). | 10 |
| | 2. Sequence analysis | Various file formats for bio-molecular sequences-genbank, fasta, gcg, msf, nbrf-pir etc.<br>• Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues. | 10 |

| | | | |
|---|---|---|---|
| | | • Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.<br>• Sequence-based Database Searches: what are sequence-based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA. | |
| | 3. Pairwise and Multiple sequence alignments | Basic concepts of sequence alignment, Needleman &Wuncsh, Smith & Waterman algorithms for pairwise alignments, Progressive and hierarchical algorithms for MSA. Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results. | 10 |
| **Unit-2** | 4. Phylogeny | Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees: distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method. | 10 |
| | 5. Current Advancements in Bioinformatics | Introduction to System Biology, Structural Biology, Structural bioinformatics, Chemo-informatics, Immuno-informatics etc. | 08 |

**Total=48**

**Recommended Books:**

1. Introduction to Bioinformatics by Aurther M lesk
2. Developing Bioinformatics Computer Skills By: Cynthia Gibas, Per Jambeck.
3. David W. Mount; Bioinformatics: Sequence and Genome Analysis; CSHL Press; 1st edition, 2001.
4. Andreas D. Baxevanis, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience, 3rd edition 2004

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Cloud Computing Lab**

Subject Code : **PECS-823A**

Weekly load : **2 Hrs** **L T P 0 0 2**

Credit : **1**

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

| | |
|---|---|
| CO1 | Create and run virtual machines |
| CO2 | Implement Infrastructure-as-a-Service and Software-as-a-Service |
| CO3 | Understanding Amazon EC2 and Microsoft Azure services |
| CO4 | Gain in depth knowledge of various cloud services |
| CO5 | Create own cloud |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

The practical lab of Cloud Computing will cover practical use of cloud environment. The aim is to give a general understanding of cloud computing and to give the students a practical understanding of how to create virtual machines on open sources operating systems, use and implementation of Infrastructure-as-a-service and software-as-a-service. Case study of various services such as Amazon EC2, Microsoft Azure etc. Mini project such as creating a cloud like social media for the institute.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Internet of things Lab**

**Subject Code** : **PECS-823B**

**Weekly load** : **2 Hrs** **L T P: 0 0 2**

**Credit** : **1**

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

| | |
|---|---|
| CO1 | Able to understand building blocks of Internet of Things and characteristics |
| CO2 | Analyze randomized algorithms with respect to expected running time |
| CO3 | Implement own IoT models in lab |
| CO4 | To gain real working knowledge in the field of IoT. |
| CO5 | Acquire knowledge of using various types of sensors for proper working of IoT |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

The internet of things lab will help the students to acquire skills in using cutting-edge technologies and their working including:

IoT Architecture, IETF IoT Stack/ protocols, IoT hardware platforms and sensor technology, IoT system design and applications for the students to work on real mote platform. A mini project which includes system design (design choices and monitoring & actuation requirements of application) and implementation of real IoT application system (coding/troubleshooting).

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Bioinformatics Lab**

**Subject Code** : **PECS-823C**

**Weekly load** : **2 Hrs** **L T P 0 0 2**

**Credit** : **1**

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

| | |
|---|---|
| CO1 | Introduction to various bioinformatics techniques. |
| CO2 | Study and usage of various bioinformatics datasets. |
| CO3 | Use various searching techniques for data collection |
| CO4 | Depth knowledge of techniques and tools used in bioinformatics. |
| CO5 | Implement various queries on biological databases |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 1 | 1 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 3 | 1 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

In this lab the students are required to implement and understand the biological databases available on world wide web, queries based on biological databases, sequence similarity searching techniques using BLAST (Basic local alignment search tool) and pair-wise sequence alignment of (DNA, RNA, or protein) to identify regions of similarity that may be a consequence of functional, structural, or evolutionary relationships between the sequences.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Seminar**

Subject Code : **PCCS-824**

Weekly load : **2 Hrs** **L T P 0 0 2**

Credit : **1**

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

| | |
|---|---|
| CO1 | Get opportunities to develop skills in presentation and discussion of research topics in a public forum. |
| CO2 | Geta variety of research projects and activities in order to enrich their academic experience. |
| CO3 | Acquire in depth knowledge of various topics |
| CO4 | To set the stage for future recruitment by potential employers. |
| CO5 | Acquire skills in preparing presentations and report writings |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

Seminar: In this, the student must select an area from emerging technologies and give presentation on the topic. Evaluation criteria will be based on presentation skills and quality/ relevance of the topic.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Dissertation (Part-1)**

**Subject Code** : **PCCS-921**

**Weekly load** : **20 Hrs** **L T P 0 0 20**

**Credit** : **10**

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

| | |
|---|---|
| CO1 | Synthesize and apply prior knowledge to designing and implementing solutions to open-ended computational problems while considering multiple realistic constraints |
| CO2 | Design and Develop the software with software engineering practices and standards |
| CO3 | Learn effectively presentation and writing skills |
| CO4 | Analyze Database, Network and Application Design methods |
| CO5 | Evaluate the various validation and verification metho ds |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Dissertation (Part-1): In this, the student must select an area from emerging technologies and specify the objectives to be achieved. Evaluation criteria will be based on objectives stated and achieved.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Optimization Techniques**
**Subject Code** : **PECS-911A**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Describe clearly a problem, identify its parts and analyze the individual functions. Feasibility study for solving an optimization problem. |
| CO2 | Becoming a mathematical translation of the verbal formulation of an optimization problem. |
| CO3 | To design algorithms, the repetitive use of which will lead reliably to finding an approximate solution. |
| CO4 | Evaluate and measure the performance of an algorithm. Discovery, study and solve optimization problems. |
| CO5 | Investigate study, develop, orga nize and promote innovative solutions for various applications. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 7. Linear programming models | Introduction to optimization, two variable LP model, graphical LP solution, LP problems, convex set, LP model in equation form, transition from graphical to algebraic solution, the simplex method, generalized simplex tableau in matrix form, revised simplex method, artificial starting solution, special cases in the simplex method | 13 |
| | 8. Dual problems | Definition of dual problem, duality, primal-dual relationships, additional simplex algorithms (dual simplex method, generalized simplex algorithm),post optimal analysis, definition of transportation problem, the transportation algorithm, the assignment model | 12 |

| | | | |
|---|---|---|---|
| | 9. Multi objective optimization | Goal programming formulation, algorithms: the weights method and the preemptive method | 05 |
| **Unit-2** | 4. Integer programming problems | Formulation of IP problem, branch and bound method for solving IPP | 05 |
| | 5. Nonlinear programming problems | Unconstrained problems, convex and concave functions, elimination methods: direct search method, gradient of a function, descent methods: steepest descent method, Karush-Kuhn-Tucker (KKT) conditions, quadratic programming | 08 |
| | 6. Nontraditional optimization techniques | Drawbacks of the classical techniques, introduction to nontraditional optimization techniques | 05 |

**Total=48**

**Recommended Books:**

1. HA Taha, Operations Research: An Introduction, Pearson Education, 9th Edition, 2011
2. CB Gupta, Optimization in Operations Research, 2nd Edition, IK International, New Delhi, 2012
3. JC Pant, Introduction to Optimization: Operations Research, Jain Brothers , New, 6th Edition, 2004
4. WL Winston, Operations Research: Applications and Algorithms, Thomson Learning, 4th Edition, 2004

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Pattern Recognition**
**Subject Code** : **PECS-911B**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Study the fundamental algorithms for pattern recognition |
| CO2 | Investigate the various classification techniques |
| CO3 | Originate the various structural pattern recognition and feature extraction techniques |
| CO4 | Acquire knowledge of parameter estimation |
| CO5 | Study the clustering concepts and algorithms |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction | Introduction to Pattern Recognition System, The sub-problems of pattern recognition, The basic structure of a pattern recognition system, Comparing classifiers. | 04 |
| | 2. Bayes Decision Theory | Bays Decision Theory: continuous and discrete features, Classifiers, Discriminant functions and decision surfaces, Error bounds, Missing and Noisy features, Bayesian Belief networks. | 04 |
| | 3. Maximum Likelihood And Bayesian Parameter Estimation | Maximum Likelyhood estimation, Bayseian Estimation and Parameter Estimation, Component Analysis and Discriminants, Expectation-Maximization, Hidden Markov Models. | 08 |
| | 4. Nonparametric Techniques | Introduction, Density Estimation, Parzen Windows, K-nearest neighbour estimation, The nearest neighbour rule, Metrics and Nearest Neighbor classification, fuzzy classification | 06 |

| | | | |
|---|---|---|---|
| **Unit-2** | 5. Linear Discrimant Functions | Introduction, Linear Discriminant functions and Decision Surfaces, Generalized Linear Discriminant functions, Two - category Linearly separable case, Relaxation procedures, Minimum Squared Error procedures, Linear Programming Algorithms, Support Vector Machines, Multicategory Generalizations. | 06 |
| | 6. Multilayer Neural Networks ,Stochastic Methods, Non Metric Methods | Feedforward operation and classification, Backpropagation Algorithm, Additional network and training methods. Simulated Annealing and Boltzman machine. Tree Methods, Recognition with strings, Rule based methods, Grammatical Methods | 06 |
| | 7. Unsupervised Learning and Clustering | Mixture Densities and Identifiability, Maximum Likelyhood Estimates, application to normal mixtures, Unsupervised Bayesian Learning, Similarity measures, Criterion functions for clustering, Hierarchical clustering, On-line clustering, Graph-Theoretic Methods, Component Analysis, Low-Dimensional Representations and Multidimensional Scaling (MDS) | 08 |
| | 8. Applications of PR | Speech and speaker recognition, Character recognition, Scene analysis. | 06 |

**Total=48**

**Recommended Books:**

1. Richard O.Duda, "Pattern Classification", Wiley Publication.
2. Theodoridis, Koutroumbas, "Pattern Recognition",Academic Press.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Data Sciences**
Subject Code : **PECS-911 C**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | Explain how data is collected, managed and stored for data science |
| CO2 | Understand the key concepts in data science |
| CO3 | Acquire knowledge of real-world applications and the toolkit used by data scientists |
| CO4 | Get in depth knowledge of data science applications |
| CO5 | Implement data collection and management scripts using MongoDB |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Introduction to Core Concepts and Technologies | Introduction, Terminology, Data Science Process, Data Science Toolkit, Types of Data, Example Applications. | 06 |
| | 2. Data Collection and Management | Introduction, Sources of Data, Data Collection and APIs, Exploring and Fixing Data, Data Storage and Management, Using Multiple Data Sources. | 07 |
| | 3. Data Analysis | Introduction, Terminology and Concepts, Introduction to Statistics, Central Tendencies and Distributions, Variance, Distribution Properties and Arithmetic, Samples/CLT, Basic Machine Learning Algorithms, Linear Regression, SVM, Naive Bayes. | 10 |
| **Unit-2** | 4. Data Visualisation | Introduction, Types of Data Visualisation, Data for Visualisation: Data Types, Data Encodings, Retinal Variables, Mapping Variables to Encodings, Visual Encodings. | 11 |
| | 5. Applications | Applications of Data Science,Technologies for Visualisation, Bokeh (Python) | 07 |
| | 6. Recent Trends | Recent Trends in Various Data Collection and Analysis Techniques, Various Visualization Techniques, Application Development Methods of Use in Data Science. | 07 |

**Total=48**

**Recommended Books:**


1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk From The Frontline, O'Reilly.
2. Jure Leskovek, AnandRajaraman, Jeffrey Ullman, Mining of Massive Datasets, v2.1, Cambridge University Press.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Internet of Things**
**Subject Code** : **OECS-911B**
**Weekly load** : **3Hrs** **L T P: 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | Understand the application areas of IOT |
| CO2 | Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks |
| CO3 | Acquire knowledge of various types of sensors used in IoT |
| CO4 | Analyze randomized algorithms with respect to expected running time |
| CO5 | Understand building blocks of Internet of Things and characteristics |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 2. Introduction | Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT. Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security | 08 |
| | 2. Sensors | Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications<br>Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc | 08 |
| | 3. Characteristics of Sensors | Important Characteristics of Sensors: Determination of the Characteristics: Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality | 08 |

| | | | |
|---|---|---|---|
| | | Impedance Spectroscopy: Equivalent circuit of Sensors and Modeling of Sensors, Importance and Adoption of Smart Sensors. | |
| **Unit-2** | 4. Architecture and Design constraints | IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.Real-World Design Constraints- Introduction, Technical Design constraintshardware, Data representation and visualization, Interaction and remote controlArchitecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical. Vapor, Anodization, Sol-gel | 8 |
| | 5. Hardware Platforms and Physical Devices for IOT | Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device | 8 |
| | 6. Recent Trends | Recent trends in smart sensor for day to day life, evolving sensors, their architecture and IOT architecture, Automation in Industrial aspect of IOT | 8 |

**Total=48**

**Recommended Books:**


- John Vince, Foundation Mathematics for Computer Science, Springer.
- K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications.
- Wiley. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
- Alan Tucker, Applied Combinatorics, Wiley Donald E. Knuth, "The Art of Programming", Pearson Education
- Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Deep learning**
**Subject Code** : **OECS-911C**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

**Course Outcome: After completion of this course students will be able to**

| | |
|---|---|
| CO1 | This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. |
| CO2 | Be able to build, train and apply fully connected deep neural networks |
| CO3 | Know how to implement efficient (vectorized) neural networks |
| CO4 | Understand the key parameters in a neural network's architecture |
| CO5 | Understand how to build a convolutional neural network, including recent variations such as residual networks. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 1. Introduction | What is a neural network? Supervised Learning with Neural Networks, Why is Deep Learning taking off?<br>Neural network Basics: Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Gradient Descent on m Examples<br>Shallow Neural Networks: Neural Networks Overview, Neural Network Representation, Computing a Neural Network's Output, Vectorizing across multiple examples, Explanation for Vectorized Implementation, Activation functions, Why do you need non-linear activation functions?, Derivatives of activation functions, Gradient descent for Neural Networks, Back-propagation algorithm, | 08 |
| | 2. Deep neural networks | Deep L-layer neural network, Forward Propagation in a Deep Network, Getting your matrix dimensions right, Why deep representations?, Building blocks of deep neural networks, Forward and Backward Propagation, Parameters vs Hyper-parameters.<br>Practical aspects of deep learning: Train/Dev/Test sets, Bias / Variance, Regularization, Why regularization reduces over | 08 |

| | | | |
|---|---|---|---|
| | | fitting?, Dropout Regularization, Understanding Dropout, Other regularization methods, Normalizing inputs, Vanishing / Exploding gradients, Weight Initialization for Deep Networks, Numerical approximation of gradients, Gradient checking | |
| | 3. Optimization algorithms | Mini-batch gradient descent, Understanding mini-batch gradient descent, Exponentially weighted averages, Understanding exponentially weighted averages, Bias correction in exponentially weighted averages, Gradient descent with momentum, RMSprop, Adam optimization algorithm, Learning rate decay, The problem of local optima | 08 |
| Unit-2 | 4. Hyper parameter tuning, Batch Normalization and Programming Frameworks | Tuning process, Using an appropriate scale to pick hyper parameters, Hyper parameters tuning in practice: Pandas vs. Caviar, Normalizing activations in a network, Fitting Batch Norm into a neural network, Why does Batch Norm work?, Batch Norm at test time, Softmax Regression, Training a softmax classifier, Deep learning frameworks, TensorFlow. | 08 |
| | 5. Convolutional Neural Networks | Foundations of Convolutional Neural Networks: Computer Vision, Edge Detection Example, More Edge Detection, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, CNN Example, Why Convolutions?<br>Deep convolutional models: case studies, Why look at case studies?, Classic Networks, ResNets, Why ResNets Work, Networks in Networks and 1x1 Convolutions, Inception Network Motivation, Inception Network, Transfer Learning, Data Augmentation | 08 |
| | 6. Sequence Models | Recurrent Neural Networks: Why sequence models, Notation, Recurrent Neural Network Model, Back-propagation through time, Different types of RNNs, Language model and sequence generation, Sampling novel sequences, Vanishing gradients with RNNs, Gated Recurrent Unit (GRU),Long Short Term Memory (LSTM),Bidirectional RNN, Deep RNNs. | 08 |

**Total=48**

**Recommended Books:**

The required textbook for the course is

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning.
Other recommended supplemental textbooks on general machine learning:
2. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification . Wiley-Interscience. 2nd Edition. 2001.
3. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition Academic Press, 2008.
4. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
5. Bishop, C. M. Neural Networks for Pattern Recognition. Oxfor d University Press. 1995.
6. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning, Springer. 2001.
7. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Cloud Computing**
**Subject Code** : **OECS-911D**
**Weekly load** : **3Hrs** **L T P 3 0 0**
**Credit** : **3**

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

| | |
|---|---|
| CO1 | To create a brief understanding of cloud computing and other related technologies (Grid/cluster etc.). |
| CO2 | To understand cloud service models, deployment models and service inception through virtualization in cloud. |
| CO3 | To understand various security issues in cloud as well as an overview of the basic architectures of cloud computing. |
| CO4 | To understand the architecture of cloud computing up to an advance stage |
| CO5 | To understand the considerations of cloud delivery models which includes an introduction. to data center and working with IaaS, PaaS and SaaS. |

| Cos | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| **Unit-1** | 1. Understanding Cloud Computing | Origins and Influences: A Brief History, Clustering, Grid Computing, Virtualization, Technology Innovations vs. Enabling Technologies. Basic Concepts and Terminology: Cloud, IT Resource, On-Premise, Cloud Consumers and Cloud Providers, Scaling (Horizontal/Vertical), Cloud Service, Service ConsumerGoals and Benefits, Risks and Challenges, Cloud Provider, Cloud Consumer, Cloud Service Owner, Cloud Resource Administrator, Organizational Boundary, Trust Boundary. | 06 |
| | 2. Service deployment Models and Virtualization | Cloud Characteristics, Cloud Service Delivery Models: IaaS, PaaS, SaaS, Deployment Models: Public Clouds, Community Clouds, Private Clouds, Hybrid Clouds. Virtualization Technology: Hardware Independence, Server Consolidation, Operating System-Based Virtualization, Hardware-Based Virtualization, Virtualization Management. | 06 |
| | 3. Cloud Security | Basic Terms and Concepts- Confidentiality, Integrity, Authenticity, Availability, Threat, Vulnerability, Risk, | 06 |

| | | | |
|---|---|---|---|
| | | Security Controls, Security Mechanisms, Security Policies, Threat Agents- Anonymous Attacker, Malicious Service Agent, Trusted Attacker, Malicious Insider, Cloud Security Threats- Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Insufficient Authorization, Virtualization Attack. | |
| | 4. Cloud Computing Architecture | Fundamental Cloud Architectures- Architecture of Workload Distribution, Resource Pooling, Dynamic Scalability, Elastic Resource Capacity, Service Load Balancing, Cloud Bursting, Elastic Disk Provisioning, Redundant Storage | 06 |
| **Unit-2** | 5. Advance cloud computing architecture | Hypervisor Clustering, Load Balanced Virtual Server Instances, Non-Disruptive Service Relocation, Zero Downtime, Cloud Balancing, Resource Reservation, Dynamic Failure Detection and Recovery, Bare-Metal Provisioning, Rapid Provisioning Architecture, Storage Workload Management | 06 |
| | 6. Cloud Delivery Model Considerations | Building IaaS Environments, Data Centers, Equipping PaaS Environments, Optimizing SaaS Environments, Cloud Delivery Models: The Cloud ConsumerPerspective, Working with IaaS Environments, Working with PaaS Environments, Working with SaaS Services | 06 |
| | 7. Case study | Case study of a Cloud Management and Virtualization software for example Eucalyptus, VMware etc. | 12 |

**Total=48**

**Recommended Books:**

1. Thomas Erl, Zaigham Mahmood, RicardoPuttini, "Cloud Computing: Concepts, Technology and Architecture", Prentice Hall.
2. John W. Rittinghouse, James F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press.
3. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC.
4. Bunker, Darren Thomson, "Delivering Utility Computing",John Wiley and Sons Ltd.
5. George Reese, "Cloud Application Architectures", O'reilly Publications.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

Title of the course : **Cyber Security**
Subject Code : **OECS-911E**
Weekly load : **3Hrs** **L T P 3 0 0**
Credit : **3**

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

| | |
|---|---|
| CO1 | Understand the basic terminologies related to cyber security. |
| CO2 | Acquire knowledge about the type and nature of cyber crimes and as to how report these crimes through the prescribed legal and Government channels. |
| CO3 | Understand the legal framework that exists in India for cyber crimes and penalties and punishments for such crimes. |
| CO4 | Understand the aspects related to personal data privacy and security. |
| CO5 | Get insights into risk-based assessment, requirement of security controls. |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |

**Theory**

| Unit | Main Topics | Course outlines | Lecture(s) |
|---|---|---|---|
| Unit-1 | 1. Overview of Cyber security | Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies. | 10 |
| | 2. Cyber crimes | Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies. | 14 |

| | | | |
|---|---|---|---|
| Unit-2 | 3. Cyber Law | Cyber crime and legal landscape around the world, IT Act,2000 and its amendments and limitation. Cyber crime and punishments, Cyber Laws, Legal and Ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies. | 08 |
| | 4. Data Privacy and Security | Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues. | 08 |
| | 5. Cyber security Management, Compliance and Framework | Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy. NIST Framework, MITRE Attack TTP's | 08 |

**Total=48**

**Recommended Books:**

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1stEdition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

# SLIET LONGOWAL

## 1.2.2 -COMPUTER SCIENCE AND ENGINEERING (PG-CSE)

**Title of the course** : **Dissertation (Part-2)**

**Subject Code** : **PCCS-921**

**Weekly load** : **32 Hrs** **L T P 0 0 32**

**Credit** : **16**

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

| | |
|---|---|
| CO1 | Synthesize and apply prior knowledge to designing and implementing solutions to open-ended computational problems while considering multiple realistic constraints |
| CO2 | Design and Develop the software with software engineering practices and standards |
| CO3 | Learn effectively presentation and writing skills |
| CO4 | Analyze Database, Network and Application Design methods |
| CO5 | Evaluate the various validation and verification methods |

| | CO/PO Mapping : (Strong(3)/Medium(2)/Weak(1) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | Program Outcomes (PO's)/ Program Specific Outcomes (PSO's) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Dissertation (Part-2): In this, the student must select an area from emerging technologies and specify the objectives to be achieved. Evaluation criteria will be based on objectives stated and achieved.