# Compiler Design

**General Course Information**

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|---|---|
| Course Code: PCC-CSE401-T/ PCC-IT306-T<br>Course Credits: 3<br>Type: Professional Core<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Brief knowledge of programming languages, Data Structure, and Algorithm Design.

**About the Course:**

Compilers have become part and parcel of today's computer systems. These are responsible for making the user's computing requirements, specified as a piece of program, understandable to the underlying machine. There tools work as interface between the entities of two different domains – the human being and the machine. The actual process involved in this transformation is quite complex. Compiler design covers basic translation mechanism and, error detection and recovery. It includes lexical, syntax, and semantic analysis as front end, and code generation and optimization as back-end.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **state** principles of compiler design. (LOTS: Level 1: Remember)
CO2. **illustrate** the essential phases for automatically converting source code into object code. (LOTS: Level 2: Understand)
CO3. **apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply)
CO4. **analyse** a parse tree and a given BNF grammar. (LOTS: Level 4: Analyse)
CO5. **compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate)
CO6. **design** a lexical analyser from the specification of a language's lexical rules. (HOTS: Level 6: Create)

## Course Content

**Unit I**

**Introduction To Compilers**: Compilers and translators, need of translators, structure of compiler its different phases, Compiler construction tools.

**Lexical Analysis**: Role of lexical analyzer, design of lexical analyzer, regular expressions, Specification and recognition of tokens, input buffering, A language specifying lexical analyzer. Finite automata, conversion from

regular expression to finite automata, and vice versa, minimizing number of states of DFA, Implementation of lexical analyzer.

**Unit II**

Syntax Analysis: Role of parsers, context free grammars, definition of parsing. Parsing Technique: Shift- reduce parsing, operator precedence parsing, top down parsing, predictive parsing.

**Unit III**

LR parsers, SLR, LALR and Canonical LR parser. Syntax Directed Translations: Syntax directed definition, construction of syntax trees, syntax directed translation scheme, implementation of syntax directed translation, three address code, quadruples and triples.

**Unit IV**

Symbol Table & Error Detection and Recovery: Symbol tables, its contents and data structure for symbol tables; trees, arrays, linked lists, hash tables. Errors, lexical phase error, syntactic phase error, semantic error.

Code Optimization & Code Generation: Code generation, forms of objects code, machine dependent code, optimization, register allocation for temporary and user defined variables.

T**ext and Reference Books:**


1. Alfread V. AHO, Ravi Sethi and J.D. Ullman, *Compilers Principle, Techniques and Tools*, Addison Wesley, 2007.
2. Tremblay and Sorenson, *Theory and practice of compiler writing*, Mc. Graw Hill, 1985.
3. Dhamdare, *System software*, MGH, 1986.
4. Alfred V. Aho, Jeffrey D. Ullman, *Principles of Compiler Design*, Narosa Publication, 2002.

## CO-PO Articulation Matrix Compiler Design Course (PCC-CSE401-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **State** principles of compiler design. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ | _ |
| CO2. **Illustrate** the essential phases for automatically converting source code into object code. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply) | 2 | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Analyse** a parse tree and a given BNF grammar. (LOTS: Level 4: Analyse) | 3 | 2 | 1 | | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO5. **Compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate) | 2 | 2 | 1 | | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO6. **Design** a lexical analyser from the specification of a language's lexical rules. (HOTS: Level 6: Create) | 3 | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| Level of Attainments PCC-CSE-401-T | | | | | | | | | | | | | | _ | _ |

# Artificial Intelligence

**General Course Information**

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|---|---|
| Course Code: PCC-CSE402-T/ PCC-IT304-T<br>Course Credits: 3<br>Type: Professional Core<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basic knowledge of Algorithms and probability.

**About the Course:**

Artificial Intelligence is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces the concepts of Artificial Intelligence and challenges inherent in building intelligent systems. It includes the role of knowledge representation in problem solving and how these are used in making intelligent machine. Further it incorporates the concepts of expert system and its applications.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** various Artificial Intelligence techniques. (LOTS: Level 1: Remember)
CO2. **illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand)
CO3. **apply** search and knowledge representation techniques to solve AI problems.(LOTS: Level 3: Apply)
CO4. **compare** strengths and weaknesses of AI algorithms (HOTS: Level 4: Analyse).
CO5. **combine** various AI techniques to solve intelligent systems' problems. (HOTS: Level 6: Create)

## Course Content

**Unit I**

**Introduction to AI:** Introduction, Turing Test, AI problems, State Space Search, production system

**Problem Solving Using Search:** Blind search techniques - Breadth first search, Depth first search. Heuristic search techniques - Generate and test, Hill Climbing, Best first search, A* Algorithm, AO* Algorithm, The Minimax Search Procedure, Adding Alpha-Beta Cut-offs.

**Unit II**

**Knowledge Representation:** Introduction, Knowledge Representation- Representation and Mappings, Symbolic Logic - Propositional logic, Predicate logic- Representing simple facts in logic, Representing Instances and ISA Relationship, Computable functions and Predicates, Unification, Resolution.

**Representing Knowledge Using Rules:** Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

**Unit III**

**Reasoning Under Uncertainty:** Introduction to Nonmonotonic Reasoning, Probability and Baye's Theorem, Certainty Factors and Rule-based Systems, Bayesian Networks.

**Fuzzy logic system:** Introduction, Crisp Set, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations.

**Unit IV**

**Planning:** Introduction, Components of Planning System, Goal Stack Planning, Nonlinear Planning using Constraint Posting, Hierarchical Planning.

**Expert System and Applications:** Introduction, Architecture, Rule based Expert Systems, Applications of Expert Systems.

T**ext and Reference Books:**


1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial intelligence*, McGraw Hill Education. 3rd edition, 2009.
2. Stuart Russel and Peter Norvig, *Artificial intelligence: A modern Approach*, Pearson Education, 3rd edition, 2015.
3. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert System*, Pearson Education.1st edition, 2007.
4. Deepak Khemani, *A first course in Artificial Intelligence*, McGraw Hill Education. 3rd edition, 1st edition, 2013.
5. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Pearson Education, 5th edition, 2009.

## CO-PO Articulation Matrix Artificial Intelligence Course (PCC-CSE402-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** various Artificial Intelligence techniques. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO2. **Illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Apply** search and knowledge representation techniques to solve AI problems. (LOTS: Level 3: Apply) | 2 | 2 | – | 2 | 2 | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Compare** strengths and weaknesses of AI algorithms (HOTS: Level 4: Analyse). | 2 | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Combine** various AI techniques to solve intelligent systems' problems. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 2 | 2 | – | – | – | – | – | 3 | – | – | 3 |
| Level of Attainments PCC-CSE402-T | | | | | | | | | | | | | | | |

# Software Project Management

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE401-T/ PEC-IT401-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Preliminary knowledge of Software Engineering.

**About the Course:**

The course involves training students in software project management and project planning. It focuses on the need for careful planning, monitoring and control for delivering quality projects in time. Besides this student learn to measure the success of a project in meeting its objectives.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** basic concepts related to stepwise project planning. (LOTS: Level 1: Remember)
CO2. **demonstrate** the knowledge about Quality Control, Standard and Risk Management. (LOTS: Level 2: Understand)
CO3. **illustrate** the Activity Planning, and Resource Allocation Process. (LOTS: Level 2: Understand)
CO4. **apply** the concept of team structure and organization structure. (LOTS: Level 3: Apply)
CO5. **compare** various Project Evaluation and Estimation Techniques. (HOTS: Level 4: Analyse)
CO6. **plan** activities necessary for completing the software projects successfully. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

**Introduction to Software Project Management(SPM):** Definition of Software Project, Software Project Vs Other types of projects, activities covered by SPM, categorizing software projects, project as system, management control, Requirement specification, Information and control in organization, project management lifecycle.

**Stepwise Project Planning:** Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analysing project characteristics, identifying the project products and activities, estimate efforts for each activity, identifying activity risk, allocate resources, review/publicize plan.

**Unit II**

**Project Evaluation and Estimation:** Cost-Benefit analysis, cash flow forecasting, cost benefit evaluation techniques, Selection of an appropriate project, choosing technologies, choice of process models, rapid application development, waterfall model, V process model and spiral model, Albrecht function point analysis.

**Activity Planning:** Objectives of activity planning, project schedule, projects and activities, sequencing and

scheduling activities, network planning model.

**Unit III**

**Risk Management:** Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to schedule, calculating z-values**.**

**Resource Allocation:** Introduction, the nature of resources, identifying resource requirements, scheduling resources, creating critical paths.

**Unit IV**

**Managing Contracts and People:** Introduction, types of contract, stages in contract placement, terms of contract, contract management, acceptance, managing people and organizing teams: Introduction, understanding organization behaviour: a back ground, selecting the right person for job, instruction in best methods, motivation, working in groups, becoming a team, decision making, leadership, organization structures.

**Software Quality:** Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, McCall's software quality factors, product versus process quality management, external standards, techniques to enhance software quality.

T**ext and Reference Books:**


1. Bob Hughes and Mike Cotterell , *Software Project Management*, Sixth Edition, TMH, 2018.
2. Walker Royce , *Software Project Management*, , Addison Wesley, 1998.
3. Pankaj Jalote , *Software Project Management in Practice*, Pearson, 2002.
4. Ramesh, *Managing Global Software Projects*, TMH, 2005.

## CO-PO Articulation Matrix Software Project Management Course (PEC-CSE401-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** basic concepts related to stepwise project planning. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ | _ |
| CO2. **Demonstrate** the knowledge about Quality Control, Standard and Risk Management. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Illustrate** the Activity Planning, and Resource Allocation Process. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Apply** the concept of team structure and organization structure. (LOTS: Level 3: Apply) | 2 | 2 | _ | _ | 2 | _ | _ | _ | 2 | _ | _ | _ | 3 | _ | _ |
| CO5. **Compare** various Project Evaluation and Estimation Techniques. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | 2 | _ | _ | _ | _ |  | 2 | _ | 3 | _ | _ |
| CO6. **Plan** activities necessary for completing the software projects successfully. (HOTS: Level 6: Create) | 3 | 3 | _ | 3 | 3 | _ | _ | _ | _ | 2 | 3 | 2 | 3 | _ | _ |
| Level of Attainments PEC-CSE401-T |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

# Soft Computing

**General Course Information**

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|---|---|
| Course Code: PEC-CSE402-T/ PEC-IT302-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basic knowledge of Probability Theory, Set Theory and, Data Structure and Computer Algorithms

**About the Course:**

We need to learn soft computing techniques to make intelligent machines that possess human like abilities to reason, learn and handle the uncertainty and vagueness often inherent in real world problems. Unlike conventional computing, soft computing techniques are tolerant of imprecision, uncertainty and approximations, and provide low cost, robust and tractable solutions to the complex real-world problems where conventional methods fail to do so. This introductory course on soft computing is going to cover Genetic Algorithms, Artificial Neural Networks and Fuzzy Logic.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **define** the terminology and concepts related to soft computing techniques. (LOTS: Level 1: Remember)
CO2. **discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks. (LOTS: Level 2: Understand)
CO3. **solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks. (LOTS: Level 3: Apply)
CO4. **analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems. (HOTS: Level 4: Analyse)
CO5. **justify** the design of a soft computing algorithm for a given problem. (HOTS: Level 5: Evaluate)
CO6. **design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

Introduction to Soft Computing and related definitions: Defining soft computing, Differentiating the situations for application of hard and soft computing; Working of a simple Genetic Algorithm: Representation/Encoding Schemes, initializing a GA population, evaluation function, genetic operators, Function optimization using GA.

Study of parameters of genetic algorithms and its performance, sampling and selection mechanisms. Scaling of GA population.

**Unit II**

Designing Genetic Algorithms for different applications: Different types encoding schemes, role of fitness function, different types of genetic operators, Designing GAs for numerical optimization, knapsack problem and travelling salesperson and other similar problems.

**Unit III**

Fuzzy sets: Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterisation, MFs of one and two dimensions, Derivatives of parameterised MFs, Fuzzy numbers, Extension principle and fuzzy relations, Operations on Fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Compositional rule of inference.

**Unit IV**

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem. Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

T**ext and Reference Books:**


1. David. E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*, Addison Wesley, 1999.
2. Zbigniew Michalewicz, *Genetic algorithms + Data Structures = Evolution Programs*, Springers-Verlag, 1999.
3. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications*, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, *Principles of Soft Computing*, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 1997.
7. Simon O. Haykin, *Neural Networks, A Comprehensive Foundation*, PHI, 1994.

## CO-PO Articulation Matrix Soft Computing Course (PEC-CSE402-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Define** the terminology and concepts related to soft computing techniques. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO2. **Discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks. (LOTS: Level 3: Apply) | 3 | 3 | – | – | 2 | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems. (HOTS: Level 4: Analyse) | 3 | 3 | – | 2 | 2 | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Justify** the design of a soft computing algorithm for a given problem. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 2 | – | – | – | – | – | – | – | – | – | – | 3 |
| CO6. **Design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| Level of Attainments PEC-CSE402-T | | | | | | | | | | | | | | | |

# Distributed Operating System

**General Course Information**

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|---|---|
| Course Code: PEC-CSE-403-T/ PEC-IT403-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 03 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Knowledge of operating system, computer networks and a programming language

**About the Course:**

This course focuses on the study of distributed system concepts and its applications. In this course various advantages of distributed computing system are studied. After studying this course, a student will be expected to understand the design issues of the distributed operating systems and propose solutions for problems specific to the domain.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **state** the basic concepts of distributed systems and their advantages over simple client server based computer networks. (LOTS: Level 1: Remember)
CO2. **explain** strategies for synchronization, scheduling policies and deadlock avoidance in distributed environment. (LOTS: Level 2: Understand)
CO3. **apply** distributed operating system's concepts to solve the problems inherent in distributed systems. (LOTS: Level 3: Apply)
CO4. **analyse** trends in distributed file systems. (HOTS: Level 4: Analyse)
CO5. **compare** and **contrast** strategies for synchronization, scheduling policies and deadlock avoidance and distributed file systems. (HOTS: Level 5: Evaluate)

## Course Content

**Unit I**

**Introduction:** Introduction to distributed system, Goals of distributed system, Hardware and Software concepts, Design issues, Communication in distributed system: Layered protocols, ATM networks, Client- Server model, Remote Procedure Calls and Group Communication, Middleware and Distributed Operating Systems.

**Unit II**

**Synchronization in Distributed System**: Clock synchronization, Mutual Exclusion, Election algorithm, Bully algorithm, Ring algorithm, Atomic Transactions, Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection.

**Unit-III**

**Processes and Processors in distributed systems:** Threads, System models, Processors Allocation, Scheduling in Distributed System, Real Time Distributed Systems.

**Unit IV**

**Distributed file systems:** Distributed file system design, Distributed file system Implementation, Trends in Distributed file systems. Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory.

T**ext and Reference Books:**


1. Tanenbaum A.S., Van Steen M., *Distributed Systems: Principles and Paradigms*, Pearson Education,
2. Pradeep K Sinha, *Distributed Operating Systems: Concepts and Design*, Prentice Hall of India, 2007.
3. Liu M.L., *Distributed Computing, Principles and Applications*, Pearson Education, 2004.
4. Nancy A Lynch, *Distributed Algorithms*, Morgan Kaufman Publishers, USA, 2003.

## CO-PO Articulation Matrix Distributed Operating System Course (PEC-CSE403-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **State** the basic concepts of distributed systems and their advantages over simple client server-based computer networks. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ | _ |
| CO2. **Explain** strategies for synchronization, scheduling policies and deadlock avoidance in distributed environment. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Apply** distributed operating system's concepts to solve the problems inherent in distributed systems. (LOTS: Level 3: Apply) | 2 | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Analyse** trends in distributed file systems. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO5. **Compare** and **contrast** strategies for synchronization, scheduling policies and deadlock avoidance and distributed file systems. (HOTS: Level 5: Evaluate) | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| Level of Attainments PEC-CSE403-T | | | | | | | | | | | | | | | |

# Cloud Computing

**General Course Information**

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|---|---|
| Course Code: PEC-CSE404-T/ PEC-IT-404-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basics of Computer Network, Distributed System.

**About the Course:**

The objective of the course is to give students a comprehensive view of storage and networking infrastructures for highly virtualized cloud ready deployments. The course discusses the concepts and features related to Virtualized data-centre and cloud, information storage and design of applications.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **define** concepts related to cloud computing. (LOTS: Level 1: Remember)
CO2. **express** deployment models for clouds. (LOTS: Level 2: Understand)
CO3. **apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)
CO4. **analyse** cloud computing services used at various levels. (HOTS: Level 4: Analyse)
CO5. **assess** real time cloud services. (HOTS: Level 5: Evaluate)

**Course Content**

**Unit I**

Introduction: Distributed Computing, Cluster Computing, Grid Computing, Overview of Cloud Computing, History of Cloud Computing, Defining a Cloud, Benefits of Cloud Computing, Cloud Computing Architecture, Services Models (XaaS), Infrastructure as a Service, Platform as a Service, Software as a Service.

**Unit II**

Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Dynamic Provisioning and Resource Management, Virtualization: Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization, Xen, VMware, Hyper-V.

**Unit III**

Cloud Platform in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services, Additional Services, Google App Engine- Architecture and Core Concepts, Application Life Cycle, Cost Model, Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

**Unit IV**

Cloud Application: Scientific Applications- ECG Analysis in cloud, Protein Structure Prediction, Gene Expression data analysis for Cancer Diagnosis, Satellite Image Processing, Business and Consumer Applications- CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online gaming. Cloud Security.

T**ext and Reference Books:**


1. Rajkumar Buyya, Christian Vecchiola and S ThamaraiSelvi, *Mastering Cloud Computing*, Tata McGraw Hill Education Pvt. Ltd., 2013.
2. Kai Hwang, Geofferyu C. Fox and Jack J. Dongarra, *Distributed and Cloud Computing*, Elsevier, 2012.
3. John W. Ritting and James F. Ransome, *Cloud Computing: Implementation Management and Security*, CRC press, 2012.

## CO-PO Articulation Matrix Cloud Computing Course (PEC-CSE404-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Define** concepts related to cloud computing. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ |
| CO2. **Express** deployment models for clouds. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO3. **Apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply) | 2 | 2 | 2 | _ | 2 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO4. **Analyse** cloud computing services used at various levels. (HOTS: Level 4: Analyse) | 3 | 3 | 2 | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO5. **Assess** real time cloud services. (HOTS: Level 5: Evaluate) | 3 | 3 | 3 | 3 | 3 | 2 | _ | _ | _ | _ | _ | 2 | _ | 3 | _ |
| Level of Attainments PEC-CSE404-T | | | | | | | | | | | | | | | |

# Advanced Microprocessor

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE405-T/ PEC-IT405-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.. |

**Pre-requisites**: Basic knowledge of Digital Electronics, Computer Architecture and Organization.

**About the Course and its Outcomes:**

A microprocessor incorporates the functions of a central processing unit (CPU) on a single integrated circuit. The advent of microprocessors and their increased capacity made them to be used in everything be it a smallest embedded system or handheld device, or the largest mainframe and supercomputer. It is being used in variety of applications such as process control systems, security systems, household appliances, and mobile phone technologies. This course aims to introduce the architecture, programming and interfacing of various hardware circuits with microprocessors. It would help the students learn the advanced techniques in the modern microprocessors and give them exposure to memory interfacing and management, monitoring and control applications, and the latest technologies.

**Course outcomes: By the end of the course a student would be able to:**

CO1. **describe** the features and use of the real and protected modes of microprocessors. (LOTS: Level 1: Remember)
CO2. **explain** the internal architecture of the 16, 32, and 64-bit microprocessors and compare and contrast the features of different Intel microprocessors. (LOTS: Level 2: Understand)
CO3. **analyse** memory, input/output and interrupt interfaces to the microprocessors. (HOTS: Level 4: Analyze)
CO4. **compare** the state-of-the-art technologies in the field of microprocessors.(HOTS: Level 5: Evaluate)
CO5. **design** the microprocessor based control systems and develop the software to control them. (HOTS: Level 6: Create)

## Course content

**Unit I**

Microprocessor 8086- Internal architecture, Real mode memory addressing, Protected mode memory addressing, Memory paging, Data addressing modes, Program memory addressing modes, Stack memory addressing modes, Directives and operators, Data transfer instructions, Arithmetic & logic instructions, Program control instructions, Data conversions, Assembly language programming.

**Unit II**

The Pin-Outs and pin functions of 8086 microprocessors and 8088 co-processor, Clock generator, Bus buffering and latching, Bus timings, READY and WAIT state, maximum mode and minimum mode configuration, Memory devices, Memory interface, Address decoding, 16 bit, 32 bit and 64 bit memory interface, I/O Programming, Programmed I/O, Interrupt I/O and DMA, I/O addresses and I/O ports .

**Unit III**

80286- features, Internal Architecture, bus interface, addressing modes; 80386-features, Internal Architecture, bus interface, addressing modes; 80486-features, Internal Architecture, bus interface, addressing modes; 16550 Programmable communications interface, Asynchronous serial data, Data acquisition system, Temperature monitoring system etc

**Unit IV**

Pentium processor, The memory system, I/O system, Branch prediction logic, cache structure, superscalar architecture, special Pentium registers, Pentium memory management, Introduction to Pentium pro, Pentium II, Pentium III, Pentium IV and Core 2 microprocessors, Multi-core microprocessor architecture, Intel Hyper-Threading technology, Turbo Boost technology, state-of-the-art multi-core microprocessors.

T**ext and Reference Books:**


1. Barry B. Brey, *INTEL Microprocessors*, 8th Edition, Prentice-Hall Inc., U.S.A., 2008.
2. Yu-cheng Liu, Glenn A. Gibson, *Microcomputer systems: The 8086 /8088 Family architecture, Programming and Design*, Second Edition, Prentice Hall of India, 2003
3. Walter A. Triebel, *The 80386, 80486, and Pentium Microprocessor: Hardware, Software, and Interfacing*, Prentice-Hall Inc., U.S.A., 1998.
4. K. Ray and K.M. Bhurchandi, *Intel Microprocessors: Architecture, Programming and Interfacing*, McGraw Hill Inc., 2001.
5. Shameem Akhter and Jason Roberts, *Multi-Core Programming*, Intel Press, 2006.
6. Douglas V. Hall, *Microprocessors and Interfacing: Programming and Hardware*, Tata McGraw-Hill, 1999.
7. James L. Antonakos , *The Pentium Microprocessor,* Pearson Education , 1997.

## CO-PO Articulation Matrix Advanced Microprocessor Course (PEC-CSE405-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Describe** the features and use of the real and protected modes of microprocessors. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ | _ |
| CO2. **Explain** and compare the internal architecture and features of the 16, 32, and 64-bit microprocessors (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Demonstrate** the use of microprocessor related concepts and technologies for solving problems related to hardware design. (LOTS: Level 3: Apply) | 2 | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Analyse** memory, input/output and interrupt interfaces to the microprocessors. (HOTS: Level 4: Analyze) | 2 | 3 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO5. **Compare and contrast** the state-of-the-art technologies in the field of microprocessors. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO6. **Design** the microprocessor-based control systems and develop the software to control them. (HOTS: Level 6: Create) | 3 | 3 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| Level of Attainments PEC-CSE405-T | | | | | | | | | | | | | | | |

# Mobile Application Development

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE406-T/ PCC-IT403-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Java Programming and Object-Oriented programming, Knowledge of RDBMS and OLTP.

**About the Course:**

Mobile Application Development has been introduced as a Professional Elective course for Students of BTech(CSE/IT) keeping in view the Employers' requirements. Android Platform forms the basis for developing Mobile Applications since the last decade as compared to IOS Platform for Apple Products. The Environment requires User Interface to be developed using Buttons, Check-Boxes, Alert Dialog and its kind.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **state** basic of Android , its Evolution and its Architecture. (LOTS: Level 1: Remember)
CO2. **demonstrate** the Lifecycle of Software for Android Mobile Applications. (LOTS: Level 2: Understand)
CO3. **prepare** Mobile Applications on the Android Platform. (LOTS: Level 3: Apply)
CO4. **compare** working with Buttons and other Widgets for Visual Environment. (HOTS: Level 4: Analyse)
CO5. **develop** Mobile Applications using data storage in SQLite Database and evaluate its Performance. (HOTS: Level 6: Create)

## Course content

**Unit I**

**Mobile OS Architecture**: Android, Blackberry OS, Firefox OS, IOS, Window OS, ARM and MIPS processor, Challenges of the mobile platform, Hello Android example, Internal Details, Dalvik VM, Software Stack, Android Core Building Blocks, Android Emulator, AndroidManifest.xml, R.java file, Hide Title Bar, Screen Orientation.

**Unit II**

**UI Widgets:** Working with Button, Toast, Custom Toast, Button, Toggle Button, Switch Button, Image Button, CheckBox, Alert Dialog, Spinner, AutoCompleteTextView, RatingBar, DatePicker, TimePicker, ProgressBar, Quick Contact Budge, Analog Clock and Digital Clock, Working with hardware Button, File Download.

**Unit III**

**Activity, Intent & Fragment:** Activity Lifecycle, Activity Example, Implicit Intent, Explicit Intent, Fragment Lifecycle, Fragment Example, Dynamic Fragment.

**Android Menu:** Option Menu, Context Menu, Popup Menu

**Layout Manager:** Relative Layout, Linear Layout, Table Layout, Grid Layout.

**Unit IV**

**Adaptor:** Array Adaptor, ArrayList Adaptor, Base Adaptor.
**View:** GridView, WebView, ScrollView, SearchView, TabHost, DynamicListView, Expanded ListView.
**SQLite:** SQLite API, SQLite Spinner, SQLite ListView
**XML & JSON:** XML Parsing SAX, XML Parsing DOM, XML Pull Parser, JSON basics, JSON Parsing.

T**ext and Reference Books:**


1. Redazione Io Programmo, *Android Programming*, 2011
2. John Horton, *Android Programming for Beginners*, packt publishing, 2015
3. Jason Wei, *Android Database Programming*, packt publishing, 2012
4. Mark L Murphy, *Android Programming Tutorials*, 3rd Edition, 2010
5. Bill Phillips et al., *Android Programming - The Big Nerd Ranch*" Guide 2017
6. Rick Rogers et al., *Android Application Development: Programming with the Google SDK*, 2009

## CO-PO Articulation Matrix Mobile Application Development Course (PEC-CSE406-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **State** basic of Android, its Evolution and its Architecture. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO2. **Demonstrate** the Lifecycle of Software for Android Mobile Applications. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO3. **Prepare** Mobile Applications on the Android Platform. (LOTS: Level 3: Apply) | 2 | 2 | 2 | – | 2 | – | – | – | – | – | – | – | 3 | 2 | – |
| CO4. **Compare** working with Buttons and other Widgets for Visual Environment. (HOTS: Level 4: Analyse) | – | – | 2 | – | 1 | – | – | – | – | – | – | – | 3 | – | – |
| CO5. **Develop** Mobile Applications using data storage in SQLite Database and evaluate its Performance. (HOTS: Level 6: Create) | 3 | 2 | 2 | 3 | 3 | 3 | – | – | 2 | – | 1 | 2 | 3 | 3 | – |
| Level of Attainments PEC-CSE406-T | | | | | | | | | | | | | | | |

# Multimedia Technologies

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE407-T / PEC-IT411-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end-semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basics of Computer Graphics

**About the Course:**

Multimedia is a core and an essential course for every graduate in Computer Science and Engineering The objective of this course is to make students learn how to develop multimedia programs and demonstrate how still images, sound, and video can be digitized on the computer.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** the basic concepts of multimedia technology. (LOTS: Level 1: Remember)
CO2. **discuss the concepts** of animation, digitized sound, video control, and scanned images. (LOTS: Level 2: Understand)
CO3. **use** basic instructional design principles in the development of Multimedia. (LOTS: Level 3: Apply)
CO4. **compare** various audio and video file formats. (HOTS: Level 4: Analyse)
CO5. **devise** solutions for multimedia problems. (HOTS: Level 6: Create)

**Course Content**

**Unit 1**

Introduction to Multimedia concepts, Types of Multi-media Applications,

Methods to deliver Multimedia, Introduction to Multimedia Database, Multimedia Input and Output Devices.

**Unit II**

Introduction about font and faces, Using Text in Multimedia, Applying different types of text in multimedia

Font Editing and Design tools, Hypermedia and Hypertext application.

**Unit III**

The power of images, Making Still Images, Colouring, Image File Formats (GIF, JPEG, PNG etc.)

The power of sound, MIDI Vs. Digital Audio, Audio File Formats (AIFF, WAV, MPEG, MOV etc.)

Adding Sound to multimedia project.

**Unit IV:**

Working of a Video and its Display, Digital Video Containers (Codecs & Video Format Converters)

Obtaining Video Clips, Shooting and editing Video, Non Linear Editing(NLE) in Videos

The stages of Multimedia Project, Hardware and Software requirements ,Authoring Systems

Team for Multimedia Development, Different stages of multimedia, The internet and multimedia

T**ext and Reference Books:**


1. Tay Vaughan, *Multimedia: Making It Work*, Tata McGraw Hills, 2008.
2. James E Shuman, *Multimedia in Action*, Vikas Publishing House, 1997.
3. Andreas Holzinger, *Multimedia Basics Technology*, *Volume* 1, Firewall Media, 2005.
4. Rangan Parekh, *Principles of Multimedia*, Tata McGraw Hills, 2007.

## CO-PO Articulation Matrix Multimedia Technologies Course (PEC-CSE407-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** the basic concepts of multimedia technology. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – |
| CO2. **Discuss the concepts** of animation, digitized sound, video control, and scanned images. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO3. **Use** basic instructional design principles in the development of Multimedia. (LOTS: Level 3: Apply) | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO4. **Compare** various audio and video file formats. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | – | 2 | – | – | – | – | – | – | – | 3 | – | – |
| CO5. **Devise** solutions for multimedia problems. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | 3 | – | – |
| Level of Attainments PEC-CSE407-T | | | | | | | | | | | | | | | |

# Digital Image Processing

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE408-T/ PEC-IT408-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites**: knowledge of basic linear algebra, basic probability theory, basic programming techniques, and Fourier Transforms.

**About the Course:**

Digital Image Processing is a Professional Elective course that provides a theoretical foundation of digital image processing concepts. This course provides a mathematical foundation for digital manipulation of images, image acquisition, pre-processing, enhancement, segmentation and compression. Students learn algorithms that perform basic image processing operations (e.g., histogram processing, noise removal and image enhancement and restoration). Algorithms for image analysis (e.g., image compression, image segmentation and image representation) are explained.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **state** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)
CO2. **illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)
CO3. **apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)
CO4. **compare** various image processing techniques. (HOTS: Level 4: Analyse)
CO5. **assess** the various image processing techniques for a given problem. (HOTS: Level 5: Evaluate)
CO6. **design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create)

**Course contents**

**Unit I**

Introduction and fundamental to digital image processing: What is digital image processing, Origin of digital image processing, Examples that use digital image processing, Fundamental steps in digital image processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization

and representation, Basic relationship between pixels.Image enhancement in spatial domain and frequency domain: Background, Basic gray level transformation,
Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial and the frequency domain filters.

**Unit II**

Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise, Inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations. Color Image Processing: Color fundamentals, Color models, Basics of full color image processing, Color transformations.

**Unit III**

Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression.
Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

**Unit IV**

Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors.
Recognition: Pattern and Pattern classes.

**Text and Reference Books:**


1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson Education, Ed, 2001.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson Education, PHI, 2001.
3. Tinku Acharya and Ajoy K. Ray, *Image Processing-Principles and Applications*, John Wiley & Sons,
4. Inc., 2005.
5. Chanda and D. Dutta Majumdar, *Digital Image Processing and Analysis*, PHI, 2003.
6. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis, and Machine Vision*, 2nd edition, PWS Publishing Company, Thomson Learning, 1999.

## CO-PO Articulation Matrix Digital Image Processing Course (PEC-CSE408-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **State** concepts related to image acquisition and processing. (LOTS: Level 1: Remember) | 1 | 3 | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| CO2. **Illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply) | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Compare** various image processing techniques. (HOTS: Level 4: Analyse) | 2 | 3 | 2 | 2 | – | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Assess** the various image processing techniques for a given problem. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 2 | – | – | – | – | – | – | – | – | – | – | 3 |
| CO6. **Design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | 2 | – | – | 3 |
| Level of Attainments PEC-CSE408-T | | | | | | | | | | | | | | | |

# Advanced Microprocessor Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE405-P/ PEC-IT405-P<br>Course Credits: 2<br>Type: Professional Elective Lab. Course<br>Contact Hours: 3hours/week<br>Mode: Lab. practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Knowledge of assembly language.

**About the Course:**

The Lab work on Advanced Microprocessors cultivate the ability to write the programs by mastering the assembly language programming using various concepts like addressing modes, assemblers, directives, operators, interrupts. It makes students to get acquainted with the hardware specifications of various processors and operations between the microprocessor and input/output and/or memory devices. This Lab. fosters the ability to design microprocessors based applications.

**Course outcomes: By the end of the lab course students will be able to:**

CO1. **describ**e the internal architecture of an X86 processor showing the general purpose registers, the segment registers, the ALU, the flags register, the instruction pointer (IP) register, and the instruction register. (LOTS: Level 2: Understand)
CO2. **implement** the assembly language programs for interfacing of peripherals/devices with processors. (HOTS: Level 6: Create)
CO3. **analyse** microprocessor controlled systems. (HOTS: Level 4: Analyse)
CO4. **evaluate** microprocessor controlled systems. (HOTS: Level 4: Analyse)
CO5. **create** Lab record for the assignments including aim, hardware and software requirements and solutions to given problems. (HOTS: Level 6: Create)
CO6. **demonstrate** independent enquiry, self-learning and ethical practices to solve unseen problems. (LOTS: Level 3: Apply).

**List of experiments/assignments:**

1. Three assignments on assembly language programs using 8086 Microprocessor.
2. Two assignments depicting the use of interrupts and interrupt structure.
3. Two/Three assignments based on addressing modes, operators and use of directives in assembly language programs.
4. Three assignments to show interfacing of 8086 with peripheral devices (I/O devices and memory).
5. Two assignments to design microprocessor-based applications such as rolling display.
6. Two assignments to program EEPROM chips to be used in applications such as traffic light controllers.
7. Two assignments based on Pentium multi-core microprocessors of 2.4 GHz/compatible bandwidth.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

**CO-PO Articulation Matrix Advanced Microprocessor Lab. Course (PEC-CSE405-P)**

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** the assembly language programs for interfacing of peripherals/devices with processors. (LOTS: Level 3: Apply) | 2 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – |
| CO2. **Describ**e the internal architecture of an X86 processor showing the general purpose registers, the segment registers, the ALU, the flags register, the instruction pointer (IP) register, and the instruction register. (LOTS: Level 2: Understand) | 1 | – | – | – | 2 | – | – | – | – | – | – | – | 3 | – | – |
| CO3. **Analyse** Microprocessor controlled systems. (HOTS: Level 4: Analyse) | 2 | 1 | 2 | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO4. **Evaluate** Microprocessor controlled systems. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | – | – | – | – | – | – | – | – | 3 | – | – |
| CO5. **Create** Lab record for the assignments including aim, hardware and software requirements and solutions to given problems. (HOTS: Level 6: Create) | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – |
| CO6. **Demonstrate** independent enquiry, self-learning and ethical practices to solve unseen problems. (LOTS: Level 3: Apply). | – | – | – | – | – | – | – | 3 | 3 | – | – | 3 | – | – | – |
| Level of Attainments PEC-CSE405-P | | | | | | | | | | | | | | | |

# Mobile Application Development Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE406-P/ PCC-IT403-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Java programming, Object-oriented programming, RDBMS and OLTP

**About the Course:**

This course on Mobile Application Development is a developmental lab. work on Mobile programming. It incorporates creating Applications related to Android Studio framework. The objective of the lab course is to equip the students to solve the practical Mobile problems related to Application development.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **apply** Android programming concepts for calling, display, creation and validation. (LOTS: Level 3: Apply)
CO2. **generate** solutions for content providers and permissive models. (HOTS: Level 6: Create)
CO3. **compare** the visual effects generated by Android and visual studio frameworks. (HOTS: Level 4: Analyse)
CO4. **design** applications for Android Programming by using Android Studio framework. (HOTS: Level 6: Create)
CO5. **create** lab record of the solutions for assignment. (HOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems. (LOTS: Level 3: Apply)

**List of experiments/assignments:**

1. Create “Hello World” application to display “Hello World” in the middle of the screen in red color with white background.
2. Create sample application with login module. (Check username and password), validate it for login screen or alert the user with a Toast.
3. Create and validate a login application using username as Email ID else login button must remain disabled.
4. Create a Login application and open a browser with any one search engine.
5. Create an application to display “Hello World” string the number of times user inputs a numeric value. (Example. If user enters 5, the next screen should print “Hello World” five times.)

6. Create spinner with strings from the resource folder (res >> value folder). On changing spinner value, change image.
7. Create an application to change screen color as per the user choice from a menu.
8. Create a background application that will open activity on specific time.
9. Create an application that will have spinner with list of animation names. On selecting animation name, that animation should effect on the images displayed below.
10. Create an UI listing the engineering branches. If user selects a branch name, display the number of semesters and subjects in each semester.
11. Use content providers and permissions by implementing read phonebook contacts with content providers and display in the list.
12. Create an application to call a phone number entered by the user in the Edit Text box.
13. Create an application that will create database to store username and password.
14. Create an application to insert, update and delete a record from the database.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Mobile Application Development Lab. Course (PEC-CSE406-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Apply** Android programming concepts for calling, display, creation and validation. (LOTS: Level 3: Apply) | 2 | 2 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO2. **Generate** solutions for content providers and permissive models. (HOTS: Level 6: Create) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Compare** the visual effects generated by Android and visual studio frameworks. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Design** applications for Android Programming by using Android Studio framework. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO5. **Create** lab record of the solutions for assignment. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE406-P | | | | | | | | | | | | | | | |

# Multimedia Technologies Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE407-P/ PEC-IT411-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Basic programming skills and knowledge of computer graphics.

**About the Course:**

This lab. course on Multimedia technologies involves a rigorous training on Adobe Photoshop, Macromedia Flash and blender. It incorporates solving problems related to animation and modelling framework. The objective of the lab course is to Learn to navigate and use modelling tools that will help students to gain a strong foundation in 3D design software Blender.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **apply** the fundamental principles of different elements of multimedia. (LOTS: Level 3: Apply)
CO2. **use** modern tools for applying state-of-the art multimedia technologies. (LOTS: Level 3: Apply)
CO3. **analyse** various tools for an application. (HOTS: Level 4: Analyse)
CO4. **create** elegant posters, sceneries, animated stories and movie clips. (HOTS: Level 6: Create)
CO5. **creating** record of lab experiments. ((HOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team work. (LOTS: Level 3: Apply)

**List of experiments/assignments:**

**Adobe Photoshop**

1. Introduction to Photoshop Basics.
2. Design a poster for 2019 elections and show the difference in quality and resolution for Print and Web.
3. Pick any picture of a magazine cover page and make changes using selection tool.
4. Draw a landscape using multiple Layers.
5. Paint a scenery of a park using different tools of Photoshop.
6. Take image from different Image Sources show variation in resolution.
7. Use effective cropping techniques to design a collage.
8. Design a scenery showing correction of image tonality.
9. Make a poster by adjusting Image Colours.
10. Painting the cover page of your magazine with Special Photoshop Tools.
11. Design a card on the occasion of Diwali using at least 3 different filters.
12. Make your passport size picture with all editing and print multiple copies of the same on A4 size page.

**Macromedia Flash**

13. Introduction to the layout and tools of Flash.
14. Move a car from left to right of the screen using symbols.
15. Design a movie clip.
16. Using timeline, design the casting of the movie directed by you.
17. Depict a small story using 2 D animation.

**Blender**

18. Introduction to Blender and its various tools.
19. Create an object using blender and show its motion.
20. Using Selections and Transform make a scenery.
21. Design a character for your game using modelling.
22. Depict the change in Materials, Lights and Rendering in 3 different frames.
23. Using Blender show compositing.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Multimedia Technologies Lab. Course (PEC-CSE407-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Apply** the fundamental principles of different elements of multimedia. (LOTS: Level 3: Apply) | 2 | 1 | – | – | – | – | – | – | – | – | – | – | 2 | – | – |
| CO2. **Use** modern tools for applying state-of-the art multimedia technologies. (LOTS: Level 3: Apply) | – | – | – | – | 3 | – | – | – | – | – | – | – | 3 | – | – |
| CO3. **Analyse** various tools for an application. (HOTS: Level 4: Analyse) | – | – | – | – | 3 | – | – | – | – | – | – | – | 3 | – | – |
| CO4. **Create** elegant posters, sceneries, animated stories and movie clips. (HOTS: Level 6: Create) | 2 | 2 | 2 | 3 | | – | – | – | – | – | – | – | 3 | – | – |
| CO5. **Prepare** record of lab experiments. ((HOTS: Level 6: Create) | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – |
| CO6. **Demonstrate** ethical practices, self-learning and team work. (LOTS: Level 3: Apply) | – | – | – | – | – | – | – | 3 | 3 | – | – | 3 | – | – | – |
| Level of Attainments PEC-CSE407-P | | | | | | | | | | | | | | | |

# Digital Image Processing Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE408-P/ PEC-IT408-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** The students are expected to have a knowledge of computer graphics concepts.

**About the Course:**

This Lab course on Digital Image Processing is a developmental lab. work. It incorporates transformation of images in spatial and frequency domains, compression, restoration and reconstruction of images in SCILAB/MATLAB. The objective of the lab course is to equip the students to solve the practical Image processing problems.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** digital image processing concepts for image compression, restoration and reconstruction in SCILAB/MATLAB.(LOTS: Level 3: Apply)
CO2. **verify** the results of applying image processing problems to images (compression, expansion, multi-resolution processing etc.) (HOTS: Level 4: Analyze)
CO3. **measure** the quality of image after the digital image processing techniques are implemented to an image. (HOTS: Level 5: Evaluate)
CO4. **devise** solutions for Image Processing tasks problems. (HOTS: Level 6: Create)
CO5. **design** Lab record for the assignments including aim, hardware and software requirements and solutions to the given problems. (HOTS: Level 6: Create)
CO6. **use** ethical practices, independent enquiry, self-learning and team spirit. (LOTS: Level 3: Apply).

**List of experiments/assignments**

1. Two/Three introductory assignments on SCILAB/MATLAB.
2. Two assignments on Point processing and Pixel Operations e.g scan your signature and make it clean with thresholding.)
3. One/Two assignments on Image flipping.
4. Two assignments on Image Arithmetic such as Addition, subtraction, multiplication and division.
5. Create an application to display “Hello World” string the number of times user inputs a numeric value. (Example. If user enters 5, the next screen should print “Hello World” five times.)

6. Two/Three assignments on performing Logical operations on Digital images such as NAND, NOR, EX-OR on these images.
7. Two/Three assignments on calculation and equalization of histogram for an input image.
8. Two/Three assignments on geometric transformation of image such as translation, Scaling, Rotation, Shrinking, Zooming.
9. One/Two assignments on adding noise to the image and apply image restoration techniques to improve quality of image.
10. Perform low pass and high pass filtering in frequency domain.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Digital Image Processing Lab. Course (PEC-CSE408-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** digital image processing concepts for image compression, restoration and reconstruction in SCILAB/MATLAB.(LOTS: Level 3: Apply) | 2 | 2 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO2. **Verify** the results of applying image processing problems to images (compression, expansion, multi-resolution processing etc.) (HOTS: Level 4: Analyze) | 3 | 3 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO3. **Measure** the quality of image after the digital image processing techniques are implemented to an image. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO4. **Devise** solutions for Image Processing tasks problems. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO5. **Design** Lab record for the assignments including aim, hardware and software requirements and solutions to the given problems. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Use** ethical practices, independent enquiry, self-learning and team spirit. (LOTS: Level 3: Apply). | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE408-P | | | | | | | | | | | | | | | |

# Major Project Part 1

**General Course Information**

| | |
|---|---|
| Course Code: PROJ-CSE401<br>Course Credits: 4<br>Mode: Self learning under the guidance of faculty members.<br>Contact hours: 8 hours/week | **Course Assessment Method (100)**<br>An internal evaluation is done by a committee of two teachers constituted by the Chairperson of the Department.<br>The criteria for evaluation are given below.<br>1. Literature review: 20<br>2. Problem formulation: 20<br>3. Basic knowledge of the tools: 20<br>4. Organisation and presentation of synopsis: 20<br>5. Level of Ethics followed: 20 |

## About the major project Part I:

Students start working on their project work in seventh semester. Student do the background research for identifying appropriate problems, methodology and tools for their respective project works to be culminated in eighth semester. They prepare a synopsis of the project work to be carried out. At the end of seventh semester, each student is required to prepare a synopsis in the format provided and present it in front of a committee constituted by the Chairperson of the Department. Students can carry out projects in groups of two. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

**Course Outcomes: After doing Major Project Part 1 students will be able to:**

CO1. **evaluate** critically the existing solutions and methodologies through reviewing literature. (HOTS: Level 5: Evaluate)
CO2. **formulate** suitable problems to be addressed. (HOTS: Level 6: Create)
CO3. **identify** tentative modern tools to solve the problem. (HOTS: Level 4: Analyse)
CO4. **organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)
CO5. **develop** methodologies that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)

## CO-PO Articulation Matrix Major Project Part 1 (PROJ-CSE401)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Evaluate** critically the existing solutions and methodologies through reviewing literature. (HOTS: Level 5: Evaluate) | **2** | **3** | **3** | **3** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **3** | **–** | **–** | **–** |
| CO2. **Formulate** suitable problems to be addressed. (HOTS: Level 6: Create) | **2** | **3** | **3** | **3** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** |
| CO3. **Identify** tentative modern tools to solve the problem. (HOTS: Level 4: Analyse) | **2** | **–** | **2** | **–** | **3** | **–** | **–** | **–** | **–** | **–** | **–** | **2** | **–** | **–** | **–** |
| CO4. **Organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create) | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **–** | **3** | **3** | **–** | **–** | **–** | **–** |
| CO5. **Develop** methodologies that meet ethical, societal and legal considerations. (HOTS: Level 6: Create) | **–** | **–** | **–** | **–** | **–** | **3** | **–** | **3** | **3** | **–** | **–** | **3** | **–** | **–** | **–** |
| Level of Attainments PROJ-CSE401 | | | | | | | | | | | | | | | |

# Mini Project using Open Source Tools

**General Course Information**

| | |
|---|---|
| Course Code: PROJ-CSE402<br><br>*Course Credits: 1<br><br>Mode: Design and development of mini-project in lab.<br><br>No. of hours per week: - | **Course Assessment Method (100)**<br><br>An internal evaluation is done by the course coordinator.<br><br>Significance and originality of the problem addressed and the solution provided: 20<br><br>Knowledge of the problem domain and the tool used (VIVA-VOCE):25<br><br>Report Writing: 20<br><br>Judgement of the open source tools learnt and quality of the solution developed: 20<br><br>Level of Ethics followed: 15 |

## About the mini project:

Students do a mini project using open source software after sixth semester. They are expected to learn any open source software and develop applications that can be completed within 4 to 6 weeks.

After doing mini-projects students will be able to

CO1. **identify** a suitable problem from the environment around. (HOTS: Level 4: Analyse)
CO2. **survey** the design of similar problems (HOTS: Level 5: Evaluate)
CO3. **select** suitable engineering specialisation and modern IT tools. (LOTS: Level 3: Apply)
CO4. **address** the problem in an original and innovative manner. (HOTS: Level 6: Create)
CO5. **communicate** orally as well as in written (mini project report) about the application developed. (HOTS: Level 6: Create)
CO6. **engage** in ethical practices, individual and team work, and lifelong learning. (LOTS: Level 3: Apply)

## CO-PO Articulation Matrix Mini Project using Open Source Tools Course (PROJ-CSE402)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Identify** a suitable problem from the environment around. (HOTS: Level 4: Analyse) | 2 | 3 | _ | 2 | _ | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ |
| CO2. **Survey** the design of similar problems (HOTS: Level 5: Evaluate) | _ | 3 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| CO3. **Select** suitable engineering specialisation and modern IT tools. (LOTS: Level 3: Apply) | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| CO4. **Address** the problem in an original and innovative manner. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | _ | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| CO5. **Communicate** orally as well as in written (mini project report) about the application developed. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Engage** in ethical practices and lifelong learning. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PROJ-CSE402 | | | | | | | | | | | | | | | |

# Data Mining Techniques

**General Course Information**

| | |
|---|---|
| Course Code: PCC-CSE403-T/ PCC-IT402-T<br>Course Credits: 3<br>Type: Professional Core<br>Contact Hours: 3 hours /week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Knowledge of database systems, elementary knowledge of statistics and probability.

**About the Course:**

Today's era is the era of information. Data is growing exponentially day by day. There is a need to process and analyse the data to extract knowledge from it, so that one can use that knowledge for decision making. This course provides introductory concepts of data mining and data warehousing. The course will be taught with a database as well as machine learning perspectives. The objective of the course is to provide a comprehensive understanding of data prep-processing, data mining tasks and evaluation of results obtained out of data mining processes.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember)
CO2. **explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks. (LOTS: Level 2: Understand)
CO3. **apply** various pre-processing and data mining techniques for extracting valuable information from data. (LOTS: Level 3: Apply)
CO4. **evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)
CO5. **plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

**Introduction to Data Mining:** Kind of data to be mined, Data Mining Functionalities, Technologies used in Data Mining, Applications of data Mining, Major Issues in Data Mining.

**Data Pre-Processing:** Need for preprocessing, Data Objects and Attribute types, Statistical description of data, Data Visualization, Measuring similarity and dissimilarity of data, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

**Unit II**

**Data Warehouse:** Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, Data Warehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations, Data Warehouse Implementation

**Unit III**

**Mining Associations and Correlations:** Mining Frequent Patterns, Associations and Correlations, Frequent Itemset Mining using Apriori Algorithm, Generating Association Rules from Frequent Itemsets. Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods.

**Advanced Pattern Mining:** Pattern Mining in Multilevel and Multidimensional Space, Constraint-Based Frequent Pattern Mining.

**Unit IV**

**Classification:** Introduction, Classification using Decision Tree Induction, Bayesian Classification Methods, Rule Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy. Classification by Backpropagation, Support Vector Machines and Lazy Learners.

**Cluster Analysis:** Introduction, Basic Clustering Methods, Partitioning Methods, Hierarchical Methods, Evaluation of Clustering.

T**ext and Reference Books:**


1. Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining Concepts and Techniques*, Morgan Kaufmann Publishers, Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *Introduction to Data Mining*, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, *Insight into Data Mining Theory and Practice*, Easter Economy Edition, Prentice Hall of India, 2009.
5. G. K. Gupta, *Introduction to Data Mining with Case Studies*, Prentice Hall of India, 2006.
6. Daniel T. Larose, *Data Mining Methods and Models*, Wiley, 2006.
7. W. H. Inman, *Building the Data Warehouse*, Wiley India, 2005.

## CO-PO Articulation Matrix Data Mining Techniques (PCC-CSE403-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 |
| CO2. **Explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO3. **Apply** various pre-processing and data mining techniques for extracting valuable information from data. (LOTS: Level 3: Apply) | 2 | 1 | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO4. **Evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate) | 3 | 2 | 2 | 3 | - | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO5. **Plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | - | 1 | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| Level of Attainments PCC-CSE403-T | | | | | | | | | | | | | | | |

# Internet of Things

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE409-T/ PEC-CSE409-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Fundamentals of Computer Networks

**About the Course:**

The field of Internet of Things is growing very fast. The purpose of this course is to impart the knowledge on basic concepts of IoT, its Architecture, various protocols and applications in real world scenarios.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **state** the basic concepts and key technologies of IoT. (LOTS: Level 1: Remember)
CO2. **discuss** the pros and cons of various protocols for IoT. (LOTS: Level 2: Understand)
CO3. **apply** the IOT models for business applications. (LOTS: Level 3: Apply )
CO4. **analyse** applications of IoT in real time scenario. (HOTS: Level 4: Analyse)
CO5. **design** business model scenarios (HOTS: Level 6: Create)

**Course Content**

**Unit I**

What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Basics Of Microcontroller, Microprocessor Vs Microcontroller, Types of Sensor, Actuators and their Applications.

**Unit II**

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology-Introduction, Principle of RFID, Components of an RFID system, Issues, Satellite Technology.

**Unit III**

IoT Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

**Unit IV**

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Applications: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Smart Transportation and Smart Shopping.

T**ext and Reference Books:**


1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press, 1st Edition, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , *The Internet of Things – Key applications and Protocols*, Wiley, 2nd Edition, 2012.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), *Architecting the Internet of Things*, 1st Edition, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, "*Recipes to Begin, Expand, and Enhance Your Projects*", 2nd Edition, O'Reilly Media, 2011.
5. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, 1st Edition, Universities Press, 2015.

## CO-PO Articulation Matrix Introduction to Internet of Things Course (PEC-CSE409-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **State** the basic concepts and key technologies of IoT. (LOTS: Level 1: Remember) | 1 | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ |
| CO2. **Discuss** the pros and cons of various protocols for IoT. (LOTS: Level 2: Understand) | 1 | _ | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO3. **Apply** the IOT models for business applications. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | 2 | 3 | _ |
| CO4. **Analyse** applications of IoT in real time scenario. (HOTS: Level 4: Analyse) | 3 | 3 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | 2 | 3 | 2 |
| CO5. **Design** business model scenarios (HOTS: Level 6: Create) | 3 | 3 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _3 | 3 | 2 |
| Level of Attainments PEC-CSE409-T | | | | | | | | | | | | | | | |

# Software Defined Networks

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE410-T/ PEC-IT410-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites: Programming in C/C++/Java**

**About the Course:**

Software Defined Networks is a result of improvement of flexibility of Network Control. To make the Networks Programmable it was deemed necessary to separate the Control Plane from the Data Plane. SDN Controllers are inserted into the Network to realize Network Virtualization. Openflow protocol and Mininet framework are used to design SDN. This Course is considered as a necessary addition in the Curriculum of B. Tech. (CSE/IT) from professional point of view.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** Software Defined Networks and its various components. (LOTS: Level 1: Remember)
CO2. **explain** techniques to make the Network Programmable for better flexibility. (LOTS: Level 2: Understand)
CO3. **use** of modern tools to implement SDN Controllers in a Network scenario. (LOTS: Level 3: Apply)
CO4. **breakdown** Virtual Networks into its components for controlling of networks. (HOTS: Level 4: Analyse)
CO5. **compare** and **contrast** the working of SDN through various protocols. (HOTS: Level 5: Evaluate)
CO6. **generate** SDN using Application Programming Interface and compute its performance for a given scenario. (HOTS: Level 6: Create)

## Course Content

**Unit I**

Introduction: The need for Programmable Networks, Evolution of Software Defined Networks, Software Defined Networks' Architecture and Design, Traditional Switch Architecture, Centralized and decentralized Control Plane

and Data Plane, IETF SDN framework, Scalability (Service provider Networks, ISP Automation), Reliability (QoS and Service Availability), Consistency (Configuration management and Access Control violations).

**Unit II**

Openflow and Software Defined Networks Controllers: Control and Data Plane Separation, Evolution of Openflow, SDN Controllers(POX, floodlight, openDayLight), Applicability of Openflow protocols in SDN Controllers, scalable Programming for SDN Controllers.

**Unit III**

Network Virtualization: Virtual Network, Abstraction of physical Network, Components of Virtual Network (Virtual Switch, Bridge, Host-virtual adapter, NAT device, DHCP server, Network Adapter), Network as a Service (NaaS), Network Virtual Machine.

**Unit IV**

Software Defined Networks Programming: Programming Software Defined Networks, Northbound Application Programming Interface, Current Languages and tools, Network Functions Virtualization, Software Defined Networks implementation and Applications, Bandwidth Calendaring- Data Center Orchestration, Mininet. Use-cases(Network Access Control, Virtual Customer Edge, Data center Optimization), Latest trends in SDN.

T**ext and Reference Books:**


1. Paul Goransson and Chuck Black, *Software Defined Networks: A Comprehensive Approach*, First Edition, Morgan Kaufmann, 2014.
2. Thomas D.Nadeau, Ken Gray, *Software Defined Networks*, O'Reilly Media, 2013.
3. Siamak Azodolmolky, *Software Defined Networking with Openflow, Packt Publishing*, 2013.
4. Kingston Smiler, *Openflow Cookbook*, Packt Publishing, 2015.
5. Doug Marschke, Jeff Doyle, PeteMoyer, *Software Defined Networking: Anatomy of Openflow*, Volume-I, Lulu Publishing Services, 2015.

## CO-PO Articulation Matrix Software Defined Networks Course (PEC-CSE410-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** Software Defined Networks and its various components. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – |
| CO2. **Explain** techniques to make the Network Programmable for better flexibility. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – |
| CO3. **Use** of modern tools to implement SDN Controllers in a Network scenario. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO4. **Breakdown** Virtual Networks into its components for controlling of networks. (HOTS: Level 4: Analyse) | 3 | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO5. **Compare** and **contrast** the working of SDN through various protocols. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO6. **Generate** SDN using Application Programming Interface and compute its performance for a given scenario. (HOTS: Level 6: Create) | 3 | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| Level of Attainments PEC-CSE-410-T | | | | | | | | | | | | | | | |

# Network Administration and Management

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE411-T/ PCC-IT305-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites**: Networking, protocols defined in layered Architecture, programming fundamentals**.**

**About the Course:**

Network Administration and Management is a Professional Elective course deemed to be necessary during the present era of Information Technology and Computer Science. This course deals with analyzing Network for statistics such as protocols, servers, memory, CPU etc. Network Monitoring and Management deals with different events in various types of platforms for response.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **define** Network Administration and its various components. (LOTS: Level 1: Remember)
CO2. **distinguish** Network Administration and its Management on various platforms. (LOTS: Level 2: Understand)
CO3. **classify** the output for different responses to events by interpreting Network Monitoring statistics. (LOTS: Level 3: Apply)
CO4. **separate** portions of Network for troubleshooting using various tools. (HOTS: Level 4: Analyse)
CO5. **combine** Network Administration, Network Management and Network Monitoring into a one scenario and compute the performance of the integrated environment. (HOTS: Level 6: Create)

## Course Content

**Unit I**

Network Administration: Introduction to Network Administration Approaches, Addressing, Subnetting and Supernetting, Fixed Vs Variable Masks, VLAN Principles and Configuration, Routing Concepts: Static and Dynamic Routing, Routing Protocols: RIP, OSPF, BGP. Network Address Translation (NAT), Configuring a

Windows Box as a Router, Dial-up configuration and Authentication: PPP, Radius, RAS. Configuring a DNS Server in windows, Configuring Sendmail Service, Configuring a Web Server, Configuring a Proxy Server, TCP/IP Troubleshooting: ping, traceroute, ifconfig, netstat, ipconfig.

**Unit II**

Linux Network Administration: Setting up a file server, setting up samba server, configuring Network services: installing and configuring DHCP server, installing and configuring DNS server, setting up internal NTP server, hosting http content via Apache, sharing resources in a Network.

**Unit III**

Network management: Management Standards and models, Configuration Management and auto discovery, Fault Management, Fault identification and isolation, Event correlation techniques, SNMPv1, SNMPv2: Structure of Management Information, Standard Management Information Base (MIBs), MIB-II, Network Management Functions: Accounting Management, Performance Management, Network Usage, Metrics, and Quotas, SNMPv3: Protocol, MIB.

**Unit IV**

Network Monitoring: Network Performance Monitoring, Remote Network Monitoring (RMON1): Statistics Collection, Alarms and Filters, RMON2: Monitoring Network Protocol Traffic, Application-Layer Visibility, Management Tools, Systems and Applications: Test and Monitoring tools, Integrating tools, Development tools, Web-based Enterprise Management.

T**ext and Reference Books:**


1. Mark Burgess, *Principles of Network and System Administration*, 2nd Edition, Wiley publications, 2004.
2. Craig Hunt, *TCP/IP Network Administration*, 3rd Edition, O'Reilly Publications, 2002.
3. George Splading, *Windows 2000 Administration*, Tata McGraw-Hill, 2000.
4. Tony Bautts, Terry Dawson, and Gregor N. Purdy, *Linux Network Administrator's Guide,* 3rd Edition, O'Reilly publications, 2005.

## CO-PO Articulation Matrix Network Administration and Management Course (PEC-CSE411-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Define** Network Administration and its various components. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – |
| CO2. **Distinguish** Network Administration and its Management on various platforms. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – |
| CO3. **Classify** the output for different responses to events by interpreting Network Monitoring statistics. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | 3 | – |
| CO4. **Separate** portions of Network for troubleshooting using various tools. (HOTS: Level 4: Analyse) | 2 | 3 | 2 | 2 | 3 | – | – | – | – | – | – | – | – | 3 | – |
| CO5. **Combine** Network Administration, Network Management and Network Monitoring into a one scenario and compute the performance of the integrated environment. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | 3 | – |
| Level of Attainments : PEC-CSE-411-T | | | | | | | | | | | | | | | |

# Software Testing and Quality Assurance

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE412-T/ PEC-IT412-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Software Engineering.

**About the Course:**

This course introduces students to software testing process and describes the quality assurance process and its role in software development. During the course students learns about the testing methods and tools, creating good test cases to improve the quality of software.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **recall** the process of software testing life cycle and quality assurance. (LOTS: Level 1: Remember)
CO2. **demonstrate** reusability testing on software applications. (LOTS: Level 2: Understand))
CO3. **apply** software testing tools for predicting the behavior of software applications. (LOTS: Level 3: Apply)
CO4. **identify** the test cases for software applications. (HOTS: Level 4: Analyse)
CO5. **plan** test cases and quality management activities. (HOTS: Level 6: Create)
CO6. **predict** software quality based on quality parameters and quality models. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

Introduction to Basic of software testing & Terminology, Software Development & Software Testing Life Cycle-role and activities, Necessity and Objectives of testing; Quality Concepts, Quality Control, McCall's factor model; Different Software Development Model; Object– oriented testing, Web testing, GUI testing; Elements of Software quality assurance; Quality Assurance Activities, Statistical Quality Assurance; Software Reliability, SQA plan , Quality Standards:-IEEE, CMM, ANSI.

**Unit II**

Testing Concepts, Issues and Techniques, Levels of Testing, Verification and Validation Model ; Techniques of Verification:-Peer Review, Walkthrough, Inspection, FTR ; Unit testing, Integration testing, Function Testing ; System testing, Installation Testing, Usability Testing, Regression testing, ; Performance testing:-Load Testing, Stress Testing, Security testing, Volume testing ; Acceptance testing:-Alpha testing, Beta testing, Gamma testing.

**Unit III**

Black Box Testing Methods: Equivalence partitioning, Boundary-value analysis, Error guessing, graph- based testing methods, Decision Table Testing; White Box Testing Methods: Statement coverage, Decision coverage, Condition coverage, Path testing, Data flow testing.

Test Planning & Documentation: Development plan and quality plan objectives; Testing Strategy, Test Management, Strategic Management, Operational Test Management, Managing the Test Team, Test Plans, Test Cases, Test Data, Risk Analysis.

**Unit IV**

Testing Tools, Features of test tool; Guidelines for selecting a tool; Tools and skills of tester; Static testing tools, Dynamic testing tools, Advantages and disadvantages of using tools, Introduction to open source testing tool.

**Text and reference books:**


1. M. G. Limaye, *Software Testing Principles, Techniques and Tools*, TMH, 2009.
2. Yogesh Singh, *Software Testing*, Cambridge University Press, 2016.
3. Ron Pattorn, *Software Testing*, 2nd edition, Sams, 2005.
4. Roger S. Pressman, Software Engineering- a Practitioners approach, 8th edition, McGraw Hill, 2014
5. Jeff Tian, *Software Quality Engineering: Testing, Quality Assurance and Quantifiable Improvement*, Wiley, 2005.
6. Stephan H. Kan, *Metrics and Models in Software Quality Engineering*, 2nd edition, Addison-Wesley, 2009.
7. William E. Perry, *Effective Methods of Software Testing*, 2nd edition, Wiley, 2000.

## CO-PO Articulation Matrix Software Testing and Quality Assurance Course (PEC-CSE412-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Recall** the process of software testing life cycle and quality assurance. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO2. **Demonstrate** reusability testing on software applications. (LOTS: Level 2: Understand)) | 1 | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – |
| CO3. **Apply** software testing tools for predicting the behavior of software applications. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | – | – | – | – | – | – | – | 3 | – | – |
| CO4. **Identify** the test cases for software applications. (HOTS: Level 4: Analyse) | 2 | 3 | 2 | 3 | – | – | – | – | – | – | – | – | 3 | – | – |
| CO5. **Plan** test cases and quality management activities. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | – | – | – | – | – | – | – | 3 | – | – |
| CO6. **Predict** software quality based on quality parameters and quality models. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | 3 | – | – |
| Level of Attainments PEC-CSE412-T | | | | | | | | | | | | | | | |

# Machine Learning

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE413-T/ PEC-IT413-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end-semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basics of Linear Algebra and Statistics, Basics of Probability Theory, Data Structures and Computer Algorithms.

**About the Course:**

Machine learning is the study of computer algorithms that improve their performance through experience. Machine learning draws its conceptual foundation from the fields like artificial intelligence, probability and statistics, computational complexity, cognitive science, biology and information theory etc. The course introduces some of the key machine learning algorithms and the theory that form the backbone of these algorithms. The examples of such algorithms are classification algorithms for learning patterns from data, clustering algorithms for grouping objects based on similarity, neural network algorithms for pattern recognition, genetic algorithms for searching large and complex search spaces etc.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **outline** the concepts and working of different machine learning algorithms. (LOTS: Level 1: Remember)
CO2. **interpret** the results of machine learning algorithms. (LOTS: Level 2: Understand)
CO3. **apply** machine learning concepts and algorithms to given problems. (LOTS: Level 3: Apply)
CO4. **analyse** the performance of machine learning algorithms. ((HOTS: Level 4: Analyse)
CO5. **compare and contrast** different machine learning algorithms. (HOTS: Level 5: Evaluate)
CO6. **design** machine learning algorithms for optimization, pattern recognition and search problems. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

**Introduction:** Well posed learning problems, designing a learning system, Issues in machine learning, the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate-eliminations, Inductive bias.

**Unit II**

**Supervised Learning:** Introduction to linear regression, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic regression, basic decision tree learning (ID3) algorithm, Hypothesis space search in decision tree learning algorithm, Inductive bias in decision tree learning, Issues in decision tree learning, k-nearest neighbour learning.

**Unit III**

**Unsupervised Learning:** About clustering, type of data in clustering analysis, k-means and k-medoids, DBSCAN density-based clustering method, Performance analysis of clustering algorithms,

**Artificial Neural networks:** Neural Network representations, Appropriate problems for neural network learning, Perceptron. The perceptron training rule, Gradient descent and delta rule, Multilayer Networks and back propagation algorithm.

**Unit IV**

**Bayesian Learning:** Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least-squared error hypotheses, Naïve Bayes Classifier.

**Evaluating Hypotheses:** Estimating hypothesis Accuracy, Basics of sampling theory, Error estimation and estimating Binomial proportions, The binomial distribution, Mean and variance, Bias and variance, Confidence intervals, Two sided or one sided bounds, Central limit theorem, Hypothesis testing, Comparing learning algorithms

T**ext and Reference Books:**


1. Tom M. *Mitchell, Machine Learning*, McGraw-Hill, 1997.
2. Bishop Christopher, *Pattern Recognition and Machine Learning*, Springer Verlag, 2006.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer, 2nd edition, 2009..J. Han and M. Kamber, Data Mining Concepts and Techniques, 3rd Edition, Elsevier, 2012.
4. S. Rajeshkaran, G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications*, PHI, 2003.

## CO-PO Articulation Matrix Machine Learning Course (PEC-CSE413-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Outline** the concepts and working of different machine learning algorithms. (LOTS: Level 1: Remember) | 1 | _ | _ | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO2. **Interpret** the results of machine learning algorithms. (LOTS: Level 2: Understand) | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO3. **Apply** machine learning concepts and algorithms to given problems. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO4. **Analyse** the performance of machine learning algorithms. ((HOTS: Level 4: Analyse) | 3 | 3 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO5. **Compare and contrast** different machine learning algorithms. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO6. **Design** machine learning algorithms for optimization, pattern recognition and search problems. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| Level of Attainments PEC-CSE413-T | | | | | | | | | | | | | | | |

# Big Data Analytics

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE414-T/ PEC-IT414-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basics of statistics and data mining.

**About the Course:**

This course aims to provide students with the knowledge of current challenges, methodologies and technologies in processing big data. Emphasis will be placed on the students' understanding of the rationales behind the technologies and the students' ability to analyse big data using professional packages and tools.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **recall** the concepts of big data analysis. (LOTS: Level 1: Remember)
CO2. **interpret** the outcomes of big data analysis. (LOTS: Level 2: Understand)
CO3. **apply** technical skills and modern tools for descriptive and predicative modelling. (LOTS: Level 3: Apply)
CO4. **analyse** a framework for visualization of big data analytics for business user. (HOTS: Level 4: Analyse)
CO5. **examine** critically the results of mining to support business decision-making. (HOTS: Level 5: Evaluate)
CO6. **design** schemes for big data analytics for solving big data problems in efficient manner. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

**Introduction:** Overviews of Big Data, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle Challenges of Conventional Systems, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Regression Modelling, Multivariate Analysis, Bayesian Modelling.

**Unit II**

**Mining Data Streams:** Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics, Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Prediction

**Unit III**

**Frequent Itemset and Clustering:** Mining Frequent Itemsets, Market Based Model: Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Itemsets in a Stream, Clustering based Techniques: Hierarchical, K-Means etc., Clustering High Dimensional Data, CLIQUE And PROCLUS, Frequent Pattern based Clustering Methods, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism..

**Unit IV**

**Frameworks and Visualization:** Overview of MapReduce, Hadoop, Hive, MapR, Sharding, NoSQL Databases, S3, HADOOP, Distributed File System (HDFS), Visualizations: Visual Data Analysis Techniques, Interaction Technique and Applications.

T**ext and Reference Books:**


1. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, 2007.
2. A. Rajaraman, J.D. Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2012.
3. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*, John Wiley & sons, 2012.
4. Glenn J. Myatt, *Making Sense of Data*, John Wiley & Sons, 2007
5. Pete Warden, *Big Data Glossary*, O'Reilly, 2011.

## CO-PO Articulation Matrix Big Data Analytics Course (PEC-CSE414-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Recall** the concepts of big data analysis. (LOTS: Level 1: Remember) | 1 | 1 | _ | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 |
| CO2. **Interpret** the outcomes of big data analysis. (LOTS: Level 2: Understand) | 2 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO3. **Apply** technical skills and modern tools for descriptive and predicative modelling. (LOTS: Level 3: Apply) | 3 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO4. **Analyse** a framework for visualization of big data analytics for business user. (HOTS: Level 4: Analyse) | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO5. **Examine** critically the results of mining to support business decision-making. (HOTS: Level 5: Evaluate) | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO6. **Design** schemes for big data analytics for solving big data problems in efficient manner. (HOTS: Level 6: Create) | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| Level of Attainments PEC-CSE414-T | | | | | | | | | | | | | | | |

# Web Development

**General Information**

| | |
|---|---|
| Course Code: PEC-CSE415-T/ PEC-IT415-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **C Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end-semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** knowledge of Computer Basics

**About the Course:**

Web development is a management of information. Web Development is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces web designing tools like HTML, XML, Java Script and ASP/JSP etc. and various web site will be designed with the help of these tools for solving real world problems. It includes various types of website. Further, It is more useful for dynamic programming as well.

**Course Outcomes: By the end of the course students will be able to:**

CO 1. **enlist** principles of Information Architecture for Web design. (LOTS: Level 1: Remember)
CO 2. **explain** navigational systems, labeling systems, and taxonomies for websites. (LOTS: Level 2: Understand)
CO 3. **apply** basic web designing tools (HTML, XML, ASP/JSP, JQuery, Java Script). (LOTS: Level 3: Apply)
CO 4. **evaluate** critically design of webpages based on various technologies. (HOTS: Level 5: Evaluate)
CO 5. **create** a report describing or making recommendations for a website design. (HOTS: Level 6: Create)

**Course Content**

**Unit - I**

Information Architecture, Role of Information Architect, Collaboration and Communication, Organizing Information, Organizational Challenges, Organizing Web Sites and Intranets, Creating Cohesive Organization Systems Designing, Navigation Systems, Types of Navigation Systems, Integrated Navigation Elements, Remote Navigation Elements, Designing Elegant Navigation Systems, Searching Systems, Designing the Search Interface, Indexing the Right Stuff, What to Search or not to Search, Grouping Content, Conceptual Design, Architecture Blueprints, Architectural Page Mockups, Design Sketches.

**Unit - II**

Structured Information, Design and Documentation, XML Web 6.0, JDBC, Metadata, Unstructured Information, Techniques for Unstructured Information, HTML Basic Concepts, Good Web Design, Process of Web Publishing, Phases of Web Site Development, Structure of Html Documents, Html Elements for Designing Pages. Text Level Events, Linking Basics, Linking In Html, Images and Anchors Attributes, Image Maps, Semantic Linking Meta Information, Image Preliminaries, Images, Layout Design, Advanced Layout. Audio Support in Browsers, Video Support, Other Binary Formats. Style Sheets, Positioning With Style Sheets. Basic Interactivity and Html: Forms, Forms Control, Advance HTML and Web Designing.

**Unit - III**

Alternative Technologies for Designing, The Hypertext Transport Protocol, URLs, HTTP, Browser Requests, Server Responses, Proxies, Content Negotiation, The Common Gateway Interface, The CGI Environment Variables. CGI Output, Forms and CGI, Sending Data to the Server, Form Tags, Decoding Form Input, Architectural Guidelines, Coding Guidelines, Efficiency and Optimization. JSP Basics, Integrating Scripts in JSPs, ASP Objects and Components, JSP: Request and Response Objects, Retrieving the Contents of a HTML form, retrieving a Query String, Cookies, Creating and Reading Cookies.

**Unit - IV**

XML basics, Relationship between HTML, SGML, and XML, Valid Documents. Ways to use XML, XML for Data Files, Embedding XML into HTML documents, Converting XML to HTML for DISPLAY, Displaying XML using CSS and XSL, Rewriting HTML as XML, Basics of Advance Web Development Tools.

T**ext and Reference Books:**


1. Thomas A Powell, *HTML-The Complete Reference*, Tata McGraw Hill, 2003.
2. Scott Guelich, Shishir Gundavaram, Gunther Birzniek, *CGI Programming with Perl* 2nd edition, O'Reilly, 2000.
3. Doug Tidwell, James Snell, Pavel Kulchenko, *Programming Web Services with SOAP*, O'Reilly, 2009.
4. Young, *XML Step by Step*, 2nd edition, PHI.
5. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, *Internet & World Wide Web How to Program*, 5th edition, 2008.

## CO-PO Articulation Matrix Web Development Course (PEC-CSE415-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Enlist** principles of Information Architecture for Web design. (LOTS: Level 1: Remember) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 2 | _ | _ |
| CO2. **Explain** navigational systems, labeling systems, and taxonomies for websites. (LOTS: Level 2: Understand) | 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Apply** basic web designing tools (HTML, XML, ASP/JSP, JQuery, Java Script). (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | 3 | 2 | _ |
| CO4. **Evaluate** critically design of webpages based on various technologies. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | 3 | 2 | _ |
| CO5. **Create** a report describing or making recommendations for a website design. (HOTS: Level 6: Create) | _ | _ | _ | 3 | 3 | _ | _ | 3 | 3 | 3 | 2 | _ | 3 | _ | _ |
| Level of Attainments PEC-CSE415-T | | | | | | | | | | | | | | | |

# Statistical Computing

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE416-T/ PEC-IT416-T<br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3 hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** Basics of probability

**About the Course:**

It is important to know essentials of statistics to become a successful data analyst or researcher. This course is tailored to introduce the graduating engineering to the fundamentals of statistics so that they can analyze data and draw inference from it.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **define** basic tools of data analysis. (LOTS: Level 1: Remember)
CO2. **explain** the concepts given in descriptive and inferential statistics (LOTS: Level 2: Understand)
CO3. **apply** statistical concepts to solve real world statistical computing problems. (LOTS: Level 3: Apply)
CO4. **analyse** the trends in data using descriptive statistics. (HOTS: Level 4: Analyse)
CO5. **interpret and evaluate** statistical models. (HOTS: Level 5: Evaluate)
CO6. **conclude** the findings of statistical analysis. (HOTS: Level 6: Create)

**Course Content**

**Unit I**

**Review of Descriptive Statistics and Probability Theory:** Scale of measurement and data types, Descriptive statistics, Frequency Tables and graphs, Relative frequency tables and graphs, grouping data, histograms and ogive, mean, median, mode, variance and standard deviation of sample data, Sample spaces and events, Axioms, Conditional Probability, Independent event, Bayes Theorem, Binomial Theorem.

**Unit II**

**Random Variable and Distributions:** Random variables, type of random variables, Mean (Expectation) and variance of a discrete random variables, Discrete uniform distribution, Bernoulli's distribution, Binomial distribution, Geometric distribution, Poisson's distribution, Mean and variance of a continuous random variable, Continuous uniform distribution: normal distribution, exponential distribution, Central Limit Theorem.

**Unit III**

**Hypothesis testing:** determining levels of significance, Types of hypothesis testing errors, Hypothesis testing for population mean for large and small samples; Comparing two population means for large and small independent samples; Comparing two population means for paired samples; Comparing two population proportions, Chi-Square, t test and F test, Analysis of variance (ANOVA).

**Unit IV**

**Statistical Learning and Linear Regression:** Definition of statistical learning, Estimating a function f, The trade of between prediction accuracy and model comprehensibility, Regression versus Classification problems, Measuring the quality of fit, Bias and Variance trade off, Linear Regression between variables, Estimating the Coefficients, accessing the accuracy of the coefficient estimates, assessing the accuracy of the model, Multiple linear regression, estimating the multiple regression.

T**ext and Reference Books:**


1. Ross Sheldon M., *Introduction to Probability and Statistics for Engineers and Scientists*, 4th edition, Academic Press, 2009.
2. Douglas S. Shafer and Zhang Zhiyi, *Beginning Statistics*, 2012. [Available freely online under Creative Commons by-nc-sa 3.0 license]
3. Brain S. Everitt, *A Handbook of Statistical Analysis Using R*, Second Edition, LLC 2014
4. Roger D. Peng, *R Programming for Data Science*, Lean Publishing, 2015.
5. Michael J. Crawley, *Statistics, An introduction using R*, Second edition, John Wiley, 2015
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer, 2nd edition, 2009.

## CO-PO Articulation Matrix Statistical Computing Course (PEC-CSE-416-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Define** basic tools of data analysis. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO2. **Explain** the concepts given in descriptive and inferential statistics (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Apply** statistical concepts to solve real world statistical computing problems. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Analyse** the trends in data using descriptive statistics. (HOTS: Level 4: Analyse) | 2 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Interpret and evaluate** statistical models. (HOTS: Level 5: Evaluate) | 2 | 2 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO6. **Conclude** the findings of statistical analysis. (HOTS: Level 6: Create | 2 | 3 | 2 | 3 | – | – | – | – | – | – | – | – | – | – | 3 |
| Level of Attainments PEC-CSE416-T | | | | | | | | | | | | | | | |

# Digital Forensics

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE417-T/ PEC-IT406-T<br><br>Course Credits: 3<br>Type: Professional Elective<br>Contact Hours: 3hours/week<br>Mode: Lectures (L)<br>Examination Duration: 3 hours | **Course Assessment Methods (internal: 30; external: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks).<br>For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units. |

**Pre-requisites:** working knowledge of Windows/Macintosh/Linux, Network security.

**About the Course:**

The course on Digital Forensics is an inevitable study in this information era. Computer crimes are on a hike by the hackers and cyber criminals. The need to recover the deleted, hidden and corrupted files on Windows/Macintosh/Linux platforms give an opportunity to offer digital forensics automating features. This will give students a chance to study laws of court against computer crimes committed intentionally or inadvertently.

**Course outcomes: By the end of the course students will be able to:**

CO1. **determine** the hardware and operating system requirements for digital forensics.(LOTS: Level 1: Remember)
CO2. **represent** digital forensics by organization of data and metadata in computer systems.(LOTS: Level 2: Understand)
CO3. **analyze** file recovery and hidden file extraction techniques. (HOTS: Level 4: Analyze)
CO4. **identify** various types of forensics in the arena of information technology. (HOTS: Level 4:Analyze)
CO5. **critic** the computer crimes by studying the security Laws and legal Landscape around the world.(HOTS: Level 5: Evaluate)
CO6. **integrate** security of computer systems with digital forensics and evaluate its performance. (HOTS: Level 6: create)

## Course content

**Unit I**

Introduction to Digital Forensics: digital crimes, digital investigation, evidence, extraction, preservation etc.; overview of hardware and operating systems: structure of storage media/devices, Windows/Macintosh/Linux-registry, boot process; disk and file system analysis, data acquisition of physical storage devices.

**Unit II**

Data recovery: identifying hidden data, recovering deleted files; digital evidence controls: uncovering attacks that evade detection by event viewer, task manager and other windows GUI tools; disk imaging, recovering swap files, temporary and cache files; automating analysis and extending capabilities.

**Unit III**

Network Forensics: collecting and analyzing network-based evidence, reconstructing web browsing, email activity, intrusion detection, tracking offenders, windows registry changes, etc.; Mobile Network forensics: introduction, investigations, collecting evidences, where to seek digital data for further investigations; Email and database forensics; memory acquisition.

**Unit IV**

Computer crime and legal issues: intellectual property, privacy issues, criminal justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation and deposition of legal evidence in a court of law.

T**ext and Reference Books:**


1. Thomas J Holt , Adam M Bossler, Kathryn C Seigfried-Spellar, *Cybercrime and Digital Forensics: An Introduction*, Routledge, 2015.
2. Cory Altheide and Harlan Carvey, *Digital Forensics with Open Source Tools,* Elsevier publication, April 2011.
3. B. Nelson, A. Phillips, F. Enfinger, C. Steuart, *Guide to Computer Forensics and Investigations* 4th edition, Thomson, 2009.
4. Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters, *The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory*, july 2014.

## CO-PO Articulation Matrix Digital Forensics Course (PEC-CSE417-T)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Determine** the hardware and operating system requirements for digital forensics. (LOTS: Level 1: Remember) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – |
| CO2. **Represent** digital forensics by organization of data and metadata in computer systems. (LOTS: Level 2: Understand) | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – |
| CO3. **Analyze** file recovery and hidden file extraction techniques. (HOTS: Level 4: Analyze) | 2 | 2 | – | – | 3 | – | – | – | – | – | – | – | – | 3 | – |
| CO4. **Identify** various types of forensics in the arena of information technology. (HOTS: Level 4: Analyze) | 2 | 2 | 2 | 2 | 3 | – | – | – | – | – | – | – | – | 3 | 2 |
| CO5. **Critic** the computer crimes by studying the security Laws and legal Landscape around the world. .(HOTS: Level 5: Evaluate) | 3 | 3 | 3 | 3 | – | 3 | – | 3 | – | 3 | – | – | – | 3 | – |
| **CO6. Integrate** security of computer systems with digital forensics and evaluate its performance. (HOTS: Level 6: create) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | 3 | – |
| Level of Attainments PEC-CSE417-T | | | | | | | | | | | | | | | |

# Internet of Things Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE409-P/ PEC-IT409-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)**<br>The internal assessment is based on the percentage of lab sessions attended (4 marks), timely submission of lab experiments/assignments and the quality of solutions provided in the assignments (16 marks), and an internal VIVA-VOCE (10 marks) conducted towards the end of semester.<br>The external examination is of 70 marks. The break-up of marks for external examination is based on quality of lab reports (20 marks), quality of solution(s) for the given problem(s) at the time of examination (written work + execution of program(s)) (30) and VIVA-VOCE examination (20). |

**Pre-requisites:** Basic knowledge of C/C++ language, Basics of Electronics.

**About the Course:**

This course focuses on significant components of Internet of Things. The objective of this lab course is to make the students familiar with prototype and key components of networking for development of application based on Internet of Things.

**Course outcomes: By the end of the lab course students will be able to:**

CO1. **solve** the existing problems of traditional sensor networks and wireless communication using the concepts of Internet of Things. (LOTS: Level 3: Apply)
CO2. **analyse** the working of controllers and sensors. (HOTS: Level 4: Analyse)
CO3. **compare** and contrast the existing solutions related to IOT. (HOTS: Level 5: Evaluate)
CO4. **design** solutions for practical assignments by using Internet of Things technologies. (HOTS: Level 6: Create)
CO5. **create** lab reports by presenting the ideas regarding solutions in an effective manner. (HOTS: Level 6: Create)
CO6. **demonstrate** independent enquiry, team spirit and ethical practices while solving problems. (LOTS: Level 3: Apply)

**List of experiments/assignments:**

1. In order to implement IoT practical assignments one needs the following:
    - Hardware Setup- device capable of storage and network, e.g. Raspberry Pi, Intel Galileo, Intel, Edison, Multiple sensors etc.
    - Software- Wiring Pi (C++ for Raspberry Pi), Wiring x86 (Python for Intel Edison)
    - API to connect hardware to web server
    - Web Interface
2. Two assignments to figure out input and output devices.
3. Two assignments to interface digital and analogue devices with microcontroller unit.
4. Two assignment for calibration of sensors.
5. Two assignments for receiving data from sensors serially.
6. Two assignments to read the values from sensors.

7. Two assignments based on testing of temperature sensor, integrating of temperature sensor with microcontroller, temperature control over internet.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Internet of Things Lab. Course (PEC-CSE409-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Solve** the existing problems of traditional sensor networks and wireless communication using the concepts of Internet of Things. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | 2 |
| CO2. **Analyse** the working of controllers and sensors. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | 2 |
| CO3. **Compare** and contrast the existing solutions related to IOT. (HOTS: Level 5: Evaluate) | 3 | 2 | 2 | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | 2 |
| CO4. **Combining** Internet of Things technologies for designing solutions for complex problems. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | 3 |
| CO5. **Create** lab reports by presenting the ideas regarding solutions in an effective manner. (HOTS: Level 6: Create) | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – |
| CO6. **Demonstrate** independent enquiry, team spirit and ethical practices while solving problems. (LOTS: Level 3: Apply) | – | – | – | – | – | – | – | 3 | 3 | – | 3 | – | – | – | – |
| Level of Attainments PEC-CSE409-P | | | | | | | | | | | | | | | |

# Software Defined Networks Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE410-P/ PEC-IT410-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** knowledge of Computer Networks and Java.

**About the Course:**

This course on Software Defined Networks is a development lab. which involves configuration of open switches for different platforms. It incorporates setting up of hosts to be connected to a Network through SDN Controllers installed on servers. The objective of the lab course is to equip the students to solve the issues related to Openflow protocol through OpenFlow Standard, Mininet and OpenDaylight Controllers.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** SDN controllers using API/mininet. (LOTS: Level 3: Apply)
CO2. **analyse** results of SDN statistics for a given scenario. (HOTS: Level 4: Analyse)
CO3. **assess** performance of protocols for a given Network. . (HOTS: Level 5: Evaluate)
CO4. **hypothesize** solutions for SDN controller issues by using Network statistics. (HOTS: Level 6: Create)
CO5. **create** lab records for the assignment solutions. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

**List of experiments/assignments**

1. Introduction to the OpenFlow Standard.
2. SDN Controller concepts and interfaces using OpenDaylight Controller(Java based implementation, REST interface, OSGI module interface)
3. Implementation of centralized static and dynamic routing protocols.
4. Control plane distribution for increased availability and scalability.
5. OpenDaylight ia an open Networking Platform that enables SDN and constructs a solid foundation for Network functions Virtualization for all Network sizes. Perform virtualization in the Data Centre and in the Network.

6. OpenDaylight Controller- Brokers and RPC calls, the Datastore, plugin Development workflow, Development environment setup.
7. Testing and performance evaluation using software switches (open vSwitch), hardware switches and Network emulation (Mininet).(in group of 2-3 students)

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Software Defined Networks Lab. Course (PEC-CSE410-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** SDN controllers using API/mininet. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO2. **Analyse** results of SDN statistics for a given scenario. (HOTS: Level 4: Analyse) | 2 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO3. **Assess** performance of protocols for a given Network. . (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO4. **Hypothesize** solutions for SDN controller issues by using Network statistics. (HOTS: Level 6: Create) | 3 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO5. **Create** lab records for the assignment solutions. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE410-P | | | | | | | | | | | | | | | |

# Network Administration and Management Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE411-P/ PCC-IT305-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** knowledge of Computer Networks, System Administration, Unix/Linux Command line.

**About the Course:**

This lab. course on Network Administration and Management involves configuration of servers for different platforms. It incorporates setting up of ones' machine to be connected to a Network and checking its status frequently for any intrusion. The objective of the lab. course is to equip the students to solve the practical Administration, Management and Monitoring related problems.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **configure** a server to work as a DNS/DHCP/FTP/Web/Mail/Print server (LOTS: Level 3: Apply)
CO2. **detect** the trends in attacks through in depth attack analysis. (HOTS: Level 4: Analyse)
CO3. **formulate** solutions for Monitoring assignments by using principles of Network statistics. (HOTS: Level 6: Create)
CO4. **plan** solutions for overall security of Computer/Network systems. (HOTS: Level 6: Create)
CO5. **create** file records of solutions of assignments. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

**List of experiments/assignments:**

1. Management (creation, modification and deletion of left users) of the users & their domain.
2. Setting up the local security policy for the system, software.
3. Maintaining your system in Linux Networking and Setup Linux for firewall and IP filtering.
4. Configure the kernel for IP Accounting and IP Masquerade.
5. Install sendmail distribution and create sendmail configuration files.
6. Start and stop services from user window and command prompt.
7. Use of event viewer and performance monitor.
8. Management of the IIS and FTP server.

9. Setting up of router in Window 2000 server and Linux server.
10. Use of utilities (a) Ping(b) Tracert (c) netstat(d) net(e) IP configuration (f) Path ping
11. Monitor the Network using performance monitoring tools such as RMON, tcpdump etc.
12. Setting up of a DNS server.
13. Setting up and use "Terminal Client Services".

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Network Administration and Management Lab. Course (PEC-CSE411-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Configure** a server to work as a DNS/DHCP/FTP/Web/Mail/Print server (LOTS: Level 3: Apply) | 1 | _ | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO2. **Detect** the trends in attacks through in depth attack analysis. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO3. **Formulate** solutions for Monitoring assignments by using principles of Network statistics. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO4. **Plan** solutions for overall security of Computer/Network systems. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO5. **Create** file records of solutions of assignments. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE411-P | | | | | | | | | | | | | | | |

# Software Testing and Quality Assurance Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE412-P/ PEC-IT412-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)**<br>The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Knowledge of Software Engineering along with Programming in C/C++/Java or /MATLAB.

**About the Course:**

In this lab. Course, students learn to design, generate, minimize, and prioritize test cases of a software application using programming language or with the help of software testing tools. The lab experiments involve designing testing datasets by taking case studies and applying software testing techniques on these datasets. The course has a special focus on understanding and implementation of test results of software testing techniques to improve software quality.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** software testing using testing tools. (LOTS: Level 3: Apply)
CO2. **apply** software testing techniques for the classification of test cases. (LOTS: Level 3: Apply)
CO3. **interpret** the results of various software testing techniques. (HOTS: Level 4: Analyse)
CO4. **plan** test case activities. (HOTS: Level 6: Create)
CO5. **prepare** lab reports for software quality testing assignments. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

**List of experiments/assignments**

1. Write a program to count the number of digits in a number. Its input is any number from interval [0, 9999]. Design the boundary value analysis test cases and robustness test cases.
2. Write a program to calculate cyclomatic complexity.
3. Consider a program to perform binary search and generate the test cases using equivalence class testing and decision table based testing.
4. Write a program to determine whether a number is even or odd. Draw the program graph and DD path graph. Find the independent paths.
5. Consider the program for classification of a triangle. Consider all variables and generate possible program slices. Design at least one test case from every slice.

6. Consider the problem statement of a University Student Registration System. Prepare the software requirement checklist with the details of faults in the given SRS.
7. Write a program to generate, minimize and prioritize test cases using any programming language/Matlab Tool/Software Testing tool.
8. Write the outline of test plan document as per IEEE Std 829-1998.
9. One assignment to be done in groups.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Software Testing and Quality Assurance Lab. Course (PEC-CSE412-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** software testing using testing tools. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO2. **Apply** software testing techniques for the classification of test cases. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Interpret** the results of various software testing techniques. (HOTS: Level 4: Analyse) | 3 | 2 | 3 | 3 | | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Plan** test case activities. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | 3 | _ | 3 | _ | _ |
| CO5. **Prepare** lab reports for software quality testing assignments. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE412-P | | | | | | | | | | | | | | _ | _ |

# Machine Learning Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE-413-P/ PEC-IT413-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)**<br>The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Programming in Java, Python, R and Octave/MATLAB.

**About the Course:**

In this lab. Course, students learn to solve optimization, supervised and unsupervised learning problems using machine learning tools. Students will use machine learning tools available in WEKA, R, Python and Octave etc. The lab experiments involve downloading datasets and applying machine learning techniques on these datasets. The course has a special focus on interpreting and visualizing results of machine learning algorithms.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)
CO2. **analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)
CO3. **apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)
CO4. **compare and contrast** machine learning algorithms for a given problem. (describe datasets using descriptive statistics. (HOTS: Level 5: Evaluate)
CO5. **create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

**List of experiments/assignments**

1. Install WEKA/R/Python/Octave and learn to use these software packages.
2. Two assignments related to classification algorithms and interpreting the results of these algorithms.
3. Two assignments related to clustering algorithms and interpreting the results of these algorithms.
4. Three assignment on designing neural networks for solving learning problems.
5. Two assignment on ranking or selecting relevant features.
6. Two assignments on linear regression and logistic regression.
7. One assignment to be done in groups.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Machine Learning Lab. Course (PEC-CSE413-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO2. **Analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Apply** descriptive and predictive modelling. (LOTS: Level 3: Apply) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Compare and contrast** machine learning algorithms for a given problem. (describe datasets using descriptive statistics. (HOTS: Level 5: Evaluate) | 3 | 3 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create) | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – |
| CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply) | – | – | – | – | – | – | – | 3 | 3 | – | – | 3 | – | – | – |
| Level of Attainments PEC-CSE413-P | | | | | | | | | | | | | | | |

# Big Data Analytics Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE414-P/ PEC-IT414-P<br>Course Credits: 1<br>Type: Professional Core Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Some basic knowledge and experience of Java (JARS, Array, Classes, Objects, etc.)

**About the Course:**

This lab course provides an overview of key technology used in manipulating, storing, and analyzing big data. This incorporates big data analytics and use of Hadoop.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** solutions for big data problem. (LOTS: Level 3: Apply)
CO2. **apply** Hadoop ecosystem components. (LOTS: Level 3: Apply)
CO3. **analyse** the results of big data algorithms. (HOTS: Level 4: Analyse)
CO4. **build** and maintain reliable, scalable, distributed systems. (HOTS: Level 6: Create)
CO5. **create** lab record of the lab assignments that contains problem definitions, their solutions in big data perspective and the interpretation of the results. (HOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

## List of experiments/assignments

1. Installing and configuring Hadoop cluster.
2. Manipulating files in HDFS using Hadoop fs commands.
3. Hadoop File Systems: IBM GPFS, MapR-FS, Lustre, Amazon S3 etc.
4. Writing an Inverted Index MapReduce Application.
5. Distributed Cache MapReduce Design Patterns Sorting Joins.
6. Writing a streaming MapReduce job in Hadoop.
7. Big Data and R: Clustering, Simple Linear Regression, Decision Trees, Naïve Bayesian Classification
8. Big Data Interactions: Big Data and Cloud: Big Data and Web Services /SOA:Big Data and Internet of Things (IoT)
9. Big Data Case Study: Healthcare Data: Web Click stream Data: Social Media Data [ RSS, Tweets]

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Big Data Analytics Lab. Course (PEC-CSE414-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** solutions for big data problem. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO2. **Apply** Hadoop ecosystem components. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 2 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO3. **Analyse** the results of big data algorithms. (HOTS: Level 4: Analyse) | 3 | 2 | 2 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO4. **Build** and maintain reliable, scalable, distributed systems. (HOTS: Level 6: Create) | 2 | 3 | 3 | 3 | 3 | – | – | – | – | – | – | – | – | – | 3 |
| CO5. **Create** lab record of the lab assignments that contains problem definitions, their solutions in big data perspective and the interpretation of the results. (HOTS: Level 6: Create) | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – |
| CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply) | – | – | – | – | – | – | – | 3 | 3 | – | – | 3 | – | – | – |
| Level of Attainments PEC-CSE414-P | | | | | | | | | | | | | | | |

# Web Development Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE415-P/ PEC-IT415-P<br>Course Credits: 1<br>Type: Professional Elective Lab Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Basic programming skills and knowledge of surfing internet.

**About the Course:**

This lab. course on web development involves learning web-based programming languages. It incorporates the development of web pages by structuring information provided for the website design. The objective of the lab course is to equip the students to design web pages using modern web development tools.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** object models for website design using modern tools like HTML, XMLand JAVA scripting etc. (LOTS: Level 3: Apply)
CO2. **analyse** the design of websites. (HOTS: Level 4: Analyse)
CO3. **test** the design of websites. (HOTS: Level 5: Evaluate)
CO4. **design** websites that consider socio-cultural values. (HOTS: Level 6: Create)
CO5. **create** a written report for website designed. (HOTS: Level 6: Create)
CO6. **use** ethical practices and socio-cultural values while designing websites. (LOTS: Level 3: Apply)

**List of experiments/assignments**

1. Create a simple webpage using HTML.
2. Designing of registration form with table and use of hyperlink.
3. Design a page with frames to include Images and Videos.
4. Add a cascading style sheet for designing the web page.
5. Use user defined function to get array of values and sort them in ascending order on web page
6. Design a dynamic web page with validation of form field using JavaScript.
7. Design a catalogue in ASP.
8. Event Handling Validation of registration form.
9. Open a Window from the current window on Mouse Over event.
10. Create a simple application to demonstrate Servlets Request and Response object.

11. Demonstrate Array Objects and Date Object's predefined methods
12. Display calendar for the month and year selected from combo box
13. Create a welcome Cookie (Hit for a page) and display different image and text content each time when the user hit the page
14. Demonstrate Request and Response object using HTML Form.
15. Database Connection to display all the values in the table.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Web Development Lab. Course (PEC-CSE415-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** object models for website design using modern tools like HTML, XMLand JAVA scripting etc. (LOTS: Level 3: Apply) | 2 | 2 | 2 | _ | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO2. **Analyse** the design of websites. (HOTS: Level 4: Analyse) | 3 | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO3. **Test** the design of websites. (HOTS: Level 5: Evaluate) | 2 | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO4. **Design** websites that consider socio-cultural values. (HOTS: Level 6: Create) | 3 | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | 3 | _ | _ |
| CO5. **Create** a written report for website designed. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Use** ethical practices and socio-cultural values while designing websites. (LOTS: Level 3: Apply) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE415-P | | | | | | | | | | | | | | | |

# Statistical Computing Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE416-P/ PEC-IT416-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab. file and ethical practices followed.<br>The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department. |

**Pre-requisites:** Basic Statistics and Programming in Python, R

**About the Course:**

In this lab. Course, students learn to solve statistical computing problems using R or Python. The lab experiments involve applying statistical tools for analyzing and inferring information from real world datasets. The course has a special focus on interpreting, evaluating and concluding from the results of statistical analysis.

**Course Outcomes: By the end of the course students will be able to:**

CO1. **implement** statistical tools for drawing inference from data. (LOTS: Level 3: Apply)
CO2. **explore** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)
CO3. **apply** probability, hypothesis testing and regression for solving research questions. (LOTS: Level 3: Apply)
CO4. **Judge** different problem situations for applying appropriate statistical tests (HOTS: Level 5: Evaluate)
CO5. **create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

**List of experiments/assignments**

1. Install R and R studio.
2. Two assignments related to descriptive statistics.
3. Two assignments related to visualizing trends in data.
4. Three assignments related to permutations, combinations and probability.
5. Four assignments on Hypothesis Testing.
6. Two assignments on linear regression.
7. Two assignments on logistic regression.
8. One assignment to be done in groups.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Statistical Computing Lab. Course (PEC-CSE416-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Implement** statistical tools for drawing inference from data. (LOTS: Level 3: Apply) | 2 | 2 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO2. **Explore** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO3. **Apply** probability, hypothesis testing and regression for solving research questions. (LOTS: Level 3: Apply) | 2 | 3 | 2 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO4. **Judge** different problem situations for applying appropriate statistical tests (HOTS: Level 5: Evaluate) | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 |
| CO5. **Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE416-P | | | | | | | | | | | | | | | |

# Digital Forensics Lab.

**General Course Information**

| | |
|---|---|
| Course Code: PEC-CSE417-P/ PEC-IT406-P<br>Course Credits: 1<br>Type: Professional Elective Lab. Course<br>Contact Hours: 2 hours/week<br>Mode: Lab practice and assignments | **Course Assessment Methods (internal: 30; external: 70)** The internal assessment is based on the percentage of lab sessions attended (4 marks), timely submission of lab experiments/assignments and the quality of solutions provided in the assignments (16 marks), and an internal VIVA-VOCE (10 marks) conducted towards the end of semester.<br>The external examination is of 70 marks. The break-up of marks for external examination is based on quality of lab reports (20 marks), quality of solution(s) for the given problem(s) at the time of examination (written work + execution of program(s)) (30) and VIVA-VOCE examination (20). |

**Pre-requisites:** The students are expected to have a knowledge of components of computer system, operating systems like Windows, Macintosh, Linux.

**About the Course:**

This course on Digital Forensics is a developmental laboratory work. It incorporates file system recovery related to various operating systems. The objective of the lab course is to equip the students to solve the practical digital forensics issues.

**Course outcomes: By the end of the lab course student will be able to:**

CO1. **employ** the digital forensics tools for file system analysis. (LOTS: level 3: Apply)
CO2. **test** ethical practices while solving the problems at hand. (HOTS: level 4: Analyze)
CO3. **select** open source tools for imaging various types of media by wiping a target drive. (HOTS: level 5: evaluate)
CO4. **develop** solutions for disk imaging and like problems in different hardware conditions and for various operating systems. (HOTS: level 6: create)
CO5. **design** Lab record for the assignments including aim, hardware and software requirements and solutions to given problems. (HOTS: Level 6: Create)
CO6. **demonstrate** independent enquiry, use of ethical practices and self-learning to solve unseen problems. (LOTS: level 2: understand)

**List of experiments/assignments:**

1. Two assignments on forensically examining Window registry for evidences located in it.
2. Two assignments on wiping a target drive and ensure that it is wiped, imaging various types of media such as hard drives, USB flash drives, optical drives, ZIP disks.
3. Two assignments on system restore points and how they are valuable in a forensic investigation.
4. Two assignments on open source tool autopsy for timeline analysis, hash filtering and file system analysis.
5. Two-three assignments on open source tool caine for mobile forensics, Network forensics, data recovery.
6. Two-three assignments on Helix3 for incident response and computer forensics.

**Note:**

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of

the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

## CO-PO Articulation Matrix Digital Forensics lab. Course (PEC-CSE417-P)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 | PSO15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Employ** the digital forensics tools for file system analysis. (LOTS: level 3: Apply) | 2 | 2 | _ | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO2. **Deploy** forensics techniques/algorithms in solving problems related to the arena of Engineering/Information Technology. (LOTS: Level 3: Apply) | 2 | 3 | 2 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO3. **Select** open source tools for imaging various types of media by wiping a target drive. (HOTS: level 5: evaluate) | 2 | 2 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO4. **Develop** solutions for system restore points and like problems in different hardware conditions and for various operating systems. (HOTS: level 6: create) | 3 | 3 | 3 | 3 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ |
| CO5. **Design** Lab record for the assignments including aim, hardware and software requirements and solutions to given problems. (HOTS: Level 6: Create) | _ | _ | _ | _ | _ | _ | _ | _ | _ | 3 | _ | _ | _ | _ | _ |
| CO6. **Demonstrate** independent enquiry, use of ethical practices and self-learning to solve unseen problems. (LOTS: level 2: understand) | _ | _ | _ | _ | _ | _ | _ | 3 | 3 | _ | _ | 3 | _ | _ | _ |
| Level of Attainments PEC-CSE417-P | | | | | | | | | | | | | | | |

# Major Project II

**General Project Information**

| | |
|---|---|
| Course Code: PROJ-CSE403<br>Course Credits: 6<br>Mode: Self learning under the guidance of a faculty member. | **Course Assessment Methods (Internal evaluation: 30 marks; External Evaluation marks: 70)**<br>Evaluation is done by the internal examiner (project guide) and external examiner appointed by Controller of Examination.<br>The criteria for evaluation are given below.<br>6. Review of literature related to problem domain: 15<br>7. Significance and originality of the solution presented: 15<br>8. Application of software engineering principles and project management: 15<br>9. Significance and Scope of results: 20<br>10. Organisation and presentation of major project report: 20<br>11. Level of Ethics and societal issues covered: 15 |

**About the major project II:**

Students continue working on their project work and they are required to complete their project work by the end of 8th semester. Students carry out implementation of their respective projects based on the problem identified, methodology and tools suggested in the synopsis prepared during seventh semester. They prepare the final project reports according to the format provided. At the end of eighth semester, each student is required to present his/her project work in front of internal project guide and external examiner appointed by Controller of Examination.

**Course Outcomes: After doing major Project students will be able to:**

CO1. **review** information critically for solving complex engineering problems. (HOTS: Level 4: Analyse)
CO2. **plan** the project according to principles of project management. (HOTS: Level 6: Create)
CO3. **devise** original solutions to complex engineering problems using modern engineering tools. (HOTS: Level 6: Create)
CO4. **justify** the outcomes of the project work. (HOTS: Level 5: Evaluate)
CO5. **organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)
CO6. **develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)

## CO-PO Articulation Matrix Course (PROJ-CSE403)

| List of Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO13 | PSO14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. **Review** information critically for solving complex engineering problems. (HOTS: Level 4: Analyse) | 2 | 2 | 2 | 3 | | | | | | | | | | |
| CO2. **Plan** the project according to principles of project management. (HOTS: Level 6: Create) | 1 | 1 | 1 | | | | | | | | 3 | 3 | | |
| CO3. **Devise** original solutions to complex engineering problems using modern engineering tools. (HOTS: Level 6: Create) | 3 | 2 | 3 | 3 | 3 | 2 | | | | | | | | |
| CO4. **Justify** the outcomes of the project work. (HOTS: Level 5: Evaluate) | 3 | 3 | 3 | 3 | | 2 | | | | | | | | |
| CO5. **Organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create) | | | | | | | | | | 3 | 3 | | | |
| CO6. **Develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create) | | | | | | | | 3 | 3 | | | 3 | | |
| Level of Attainments PROJ-CSE403 | | | | | | | | | | | | | | |