Course Outcomes
B.Tech (2018 Scheme)

COURSE OUTCOMES

Course Name: Object Oriented Programming **Course Code:** PCCS-101

CO#	Statements
CO1	Develop an understanding of object-oriented programming principles and object oriented design
CO2	Use of operators, control structures, and data types with their methods
CO3	Make use of arrays and string handling methods
CO4	Design user-defined functions, modules, and packages
CO5	Investigate and implement polymorphism, inheritance, dynamic memory management and exception handling techniques to solve problems
CO6	Create and handle files in object-oriented programming

Course Name: Computer Networks **Course Code:** PCCS-102

CO#	Statements
CO1	Develop an understanding of modern network architectures from a design and performance
CO2	Understand the major concepts involved in wide-area networks (wans), local area networks (lans) and wireless lans (wlans).
CO3	Analyze various protocols to develop network related applications for future needs.
CO4	Apply the knowledge of different network designs and various logical models of networking to solve problems of communication over different medium.
CO5	Utilize knowledge of routing and congestion control algorithms to overcome various issues over different complex networking structures.
CO6	Discuss algorithms for medium access sub layer to avoid collision and error problems over different types of networks.

Course Name: Digital Electronics **Course Code:** ESCS-101

CO#	Statements
CO1	Understand the relationships between boolean algebra, combinational logic, and sequential logic.
CO2	Solve combinational logic problem formulation and logic optimization.
CO3	Construct digital logic circuits using gates and state-of-the art mux, rom, pla and pal units
CO4	Create profound analysis and design of synchronous and asynchronous sequential circuits
CO5	Design and inspect digital circuits to meet desired needs within realistic constraints.
CO6	Develop skills to build and troubleshoot digital circuits.

Course Name: Mathematics-III **Course Code:** BSCS-101

CO#	Statements
CO1	Understand partial differential equations and their solutions techniques
CO2	Understand analytic functions and evaluation of derivative of functions of complex variable
CO3	Evaluate integration of functions of complex variables
CO4	Analyze probability spaces, random variables and different probability distribution
CO5	Fit the given data into best fit curve
CO6	Apply statistical methods for analyzing experimental data

Course Name: Human values and Professional **Course Code:** HSMCS-101

CO#	Statements
CO1	Discriminate between valuable and superficial in the life.
CO2	Encourages students to discover what they consider valuable.
CO3	Understand the value required to be a good human being and apply these values in real life
CO4	Evaluate and modify the behavior.
CO5	Understand fundamental and organizational duties and protect individual and social rights.
CO6	Know about professional behavior, values and guiding principles.

Course Name: Object Oriented Programming Laboratory **Course Code:** LPCCS-101

CO#	Statements
CO1	Compare and contrast object-oriented programming paradigm with procedure-oriented programming paradigm
CO2	Design and implement efficient programs to solve computing problems in a high-level programming language
CO3	Utilize knowledge of different object-oriented principles to identify and apply the appropriate techniques in problem solving
CO4	Apply the knowledge acquired to troubleshoot programming-related problems
CO5	Utilize the knowledge and principles of object-oriented programming while working in multidisciplinary teams
CO6	Design and develop projects using object-oriented tools and techniques

Course Name: Computer Networks Laboratory **Course Code:** LPCCS-102

CO#	Statements
CO1	Analyse and configure protocols concerning various network technologies over different mediums and layers
CO2	Apply the knowledge of different network components, transmission mediums and tools to solve various problems of communication.
CO3	Design and develop different network design and logical models of networking to solve network related problems.
CO4	Utilize knowledge of modern network simulation tools to propose solution for efficient working of networks for real world problems.
CO5	make use of various troubleshooting methods to overcome networking problems.
CO6	Function in multidisciplinary teams through groups while working in different network environments with the help of resource sharing.

Course Name: Digital Electronics Laboratory **Course Code:** LESCS-101

CO#	Statements
CO1	Identify and apply the knowledge of logic gates and integrated circuits to solve related problems.
CO2	Design and implement combinational & sequential circuits for engineering problems.
CO3	Choose and compare the usage of appropriate techniques and tools to solve digital circuits problem.
CO4	Apply the knowledge acquired to demonstrate the usage of digital circuits in computers at large.
CO5	Utilize the knowledge and principles of digital electronics while working in multidisciplinary team formation
CO6	Design simple digital systems based on these digital abstractions, using the "digital paradigm".

Course Name: Training-I **Course Code:** TR-101

CO#	Statements
CO1	To acquire knowledge and skills related to different coding skills and to manage projects on globally acceptable platforms.
CO2	To provide students with opportunities for practical and hands-on learning to work in teams.
CO3	To expose students to a work environment, common practices, cognitive abilities and work ethics in the field of computer science and engineering.
CO4	To demonstrate and practice good working ethics and to internalize excellence.
CO5	To demonstrate pleasant interpersonal skills in developing understanding and appreciation of individual differences in building self-confidence.
CO6	To demonstrate presentation skills, report writing, good management, team spirit, managerial skills and quality delivery of projects undertaken.

Course Name: Seminar and Technical Report **Course Code:** PRCS-101

CO#	Statements
CO1	Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.
CO2	Analyze and critique various speech techniques, content, purpose, strengths and weaknesses.
CO3	Reference and quote correctly, and not infringe copyright.
CO4	Practice the unique qualities of professional rhetoric, writing and presentation style.
CO5	Use a technical report to communicate information
CO6	Follow the stages of the writing process (prewriting/writing/rewriting) and apply them to technical and workplace writing tasks

Course Name: Discrete Mathematics **Course Code:** PCCS-103

CO#	Statements
CO1	Apply knowledge of mathematical proofs, techniques and algorithms to solve complex engineering problem.
CO2	Prove elementary properties of modular arithmetic and explain their application in analysis and interpretation of data and synthesis of information to provide valid conclusions.
CO3	Create, select and apply appropriate techniques to model real world problems using graphs.
CO4	Identify and formulate solutions of engineering problems related to counting and probability theory.
CO5	Utilize the importance of discrete structures towards simulation of problems in multidisciplinary environments.
CO6	Formulate a logical statement in terms of a symbolic expression and evaluate the truth value of compound statement.

Course Name: Computer Architecture and Microprocessor **Course Code:** PCCS-104

CO#	Statements
CO1	Identify computer systems, memory organization, microprocessor and assembly language programming.
CO2	Clarify instruction formats, risc and cisc architecture and different addressing modes.
CO3	Solve basic binary math operations by using the instructions of microprocessor.
CO4	Compare between pipelining and parallelism.
CO5	Design structured, well commented, understandable assembly language programs to provide solutions to real-world problems.
CO6	Classify the trends and developments of microprocessor technology.

Course Name: Operating Systems **Course Code:** PCCS-105

CO#	Statements
CO1	Understand the mechanisms of os to handle processes and threads and their communication.
CO2	Compare and contrast the mechanisms involved in memory management techniques
CO3	Use the components of operating system in os design
CO4	Evaluate different scheduling techniques.
CO5	Investigate basic concepts towards process synchronization and related issues.
CO6	Understand the structure and organization of file system.

Course Name: Data Structures **Course Code:** PCCS-106

CO#	Statements
CO1	Apply knowledge of statistics and programming skills to solve complex engineering problems related to data structures.
CO2	Make use of research based knowledge to identify the appropriate data structure and provide better solution to reduce space and time complexity.
CO3	Identify, formulate and analyse data structure to develop skills and understand their applications to perform operations on it.
CO4	Design appropriate algorithm for autonomous realization of sub-programs to model complex engineering activities.
CO5	Demonstrate various methods of organizing large amounts of data and recognize systematic way to retrieve data and solve problems.
CO6	Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures.

Course Name: Software Engineering **Course Code:** PCCS-107

CO#	Statements
CO1	Plan a software engineering process life cycle, including the specification, design, and implementation.
CO2	Elicit, analyze and specify software requirements through a productive working relationship with various stakeholders of the project.
CO3	Analyze and translate a specification into a design, and then realize that design practically, using an appropriate software engineering methodology.
CO4	Develop the code from the design and effectively apply relevant standards for quality management and practice.
CO5	Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.
CO6	Identify modern engineering tools necessary for software reengineering and reverse engineering.

Course Name: Computer Architecture and Microprocessor Laboratory **Course Code:** PCCS-107

CO#	Statements
CO1	Utilize the concept of binary & hexadecimal number systems including computer arithmetic
CO2	Demonstrate the error detection & correction mechanism in computer architecture.
CO3	Understand the functional units of the processor such as the register file and arithmetic logical unit.
CO4	Examine the fundamentals of assembly language programming.
CO5	Understand the concept of computer arithmetic instruction set by designing code for arithmetic, logical and data transfer operations.
CO6	Solve basic binary math operations by using the instructions of microprocessor.

Course Name: Operating Systems Laboratory **Course Code:** LPCCS-104

CO#	Statements
CO1	Analyse the services, architectures and principles used in the design of modern operating systems.
CO2	Execute linux commands for files and directories, creating and viewing files, file comparisons and disk related commands.
CO3	Utilize the concept of virtualization for creating a virtual machine and installing operating system on virtual machine.
CO4	Demonstrate shell programming by using shell variables and shell keywords for automated system tasks.
CO5	Identify the key characteristics of multiple approaches used for the design and development of the operating system.
CO6	Apply system commands for performing the file manipulation, program execution, and printing text.

Course Name: Data Structures Laboratory **Course Code:** LPCCS-105

CO#	Statements
CO1	Apply knowledge of mathematics and programming skills to implement and analyze different data structures.
CO2	Evaluate and analyze the time and space complexity of linear and non linear data structures.
CO3	Design and implement efficient algorithms to solve computing problems in a high level programming language.
CO4	Utilize knowledge of different data structures to identify and apply the appropriate data structures to solve a real world problem.
CO5	Compare and analyze different solutions of complex engineering activities with an understanding of their advantages and limitations.
CO6	Developing an awareness of the data structure for storing data and handling various operations on different applications in the broadest context of technology change.

Course Name: Environmental Sciences **Course Code:** MCCS-101

CO#	Statements
CO1	Measure environmental variables and interpret results.
CO2	Evaluate local, regional and global environment topics related to resource use and management.
CO3	Propose solutions to environmental problems related to resource use and management.
CO4	Interpret the results of scientific studies of environmental problems
CO5	Describe threats to global biodiversity, their implications and potential solutions.

Course Name: Artificial Intelligence **Course Code: PCCS-108**

CO#	Statements
CO1	Understand the concept of artificial intelligence, agents, their types and structure.
CO2	Apply and analyze search strategies to solve the informed and uninformed problems.
CO3	Design and evaluate intelligent expert models for perception and prediction from intelligent environment.
CO4	Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.
CO5	Demonstrate and enrich knowledge to select and apply ai tools to synthesize information and develop models within constraints of application area.
CO6	Examine the issues involved in knowledge bases, reasoning systems and planning.

Course Name: Database Management System **Course Code: PCCS-109**

CO#	Statements
CO1	Analyze the information systems as socio-technical systems, its need and advantages as compared to traditional file based systems.
CO2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
CO3	Analyze database design using e-r data model by identifying entities, attributes, relationships, generalization and specialization along with relational algebra.
CO4	To understand and use data manipulation language to query, update, and manage a database
CO5	Apply and create relational database design process with normalization and denormalization of data.
CO6	To develop an understanding of essential dbms concepts such as: database security, integrity, concurrency

Course Name: Formal Language And Automata Theory **Course Code: PCCS-110**

CO#	Statements
CO1	Apply the knowledge of mathematics and statistics to solve complex engineering problems related to automata theory.
CO2	Identify, formulate and analyze uses and constraints of various computational models used in engineering practice.
CO3	Make use of research-based knowledge to abstract the models of computing and their powers to recognize the grammars.
CO4	Design and evaluate abstract machines that demonstrate the properties of physical machines and be able to specify the possible inputs, processes and outputs of these machines.
CO5	Compare and analyze different computational models including prediction and modeling to complex engineering activities with an understanding of the limitations.
CO6	Recognize and comprehend formal reasoning about machines and languages to engage in independent and life-long learning in the broadest context of technological change.

Course Name: Design and Analysis of Algorithms **Course Code: PCCS-111**

CO#	Statements
CO1	Understand and learn the fundamental techniques for designing algorithms
CO2	Learn various advanced techniques to design algorithms for solving complex problems.
CO3	Design the algorithms using basic and advanced algorithm design techniques.
CO4	Identify and design various existing algorithms based on advanced techniques.
CO5	Analyze the algorithms based on time and space complexity to find optimal algorithm for a given problem
CO6	Categorize various problems based on the complexity and properties of algorithms that solves these problems.

Course Name: Software Project Management **Course Code: PECS-101**

CO#	Statements
CO1	Understand and apply the activities involved in the management of software projects.
CO2	Analyse the various software development environments and risk management.
CO3	Develop and apply the key strategies to monitor, control and quality assurance of software projects.
CO4	Select the appropriate planning and estimation models to better evaluate the software projects.
CO5	Create a strong working knowledge of ethics and professional responsibility.
CO6	Develop effective organisational, leadership and change skills for managing projects, teams and stakeholders.

Course Name: Advanced Computer Networks **Course Code: PECS-106**

CO#	Statements
CO1	Understand the core ideas of networks thoroughly with network architecture and performance metrics for network designing.
CO2	Apply the knowledge of various modes of communication to solve problems of data communication over different medium using various technologies.
CO3	Understand and utilize various communication protocols that provide reliable, ordered, and error-checked delivery of a stream of octets.
CO4	Design and implement various algorithms of network to ease the communication problems over different geographical areas.
CO5	Compare different routing protocols and propose the optimal solution concerning different structures of networks.
CO6	Design and implementation of routing and transport layer protocols for advanced multi hop networks for smooth flow of data over different networks.

Course Name: Statistics for Data Science **Course Code: PECS-111**

CO#	Statements
CO1	Able to understand the basic knowledge on fundamental probability concepts, probability of an event, additive rules and conditional probability, bayes' theorem, combinatorial analysis, permutations ,combinations, binomial coefficients.
CO2	To understand the concept of random variables, properties of common types of random variables, how to identify them and apply them to solve probabilistic problems.
CO3	To apply the knowledge of various sampling distributions to compute confidence intervals for the population parameters.
CO4	To solve different types of statistics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
CO5	To understand basic components of hypothesis testing and perform hypothesis tests on population means, variances and proportions.
CO6	To perform statistical analysis in several circumstances and interprets the results in an applied context.

Course Name: Information Retrieval **Course Code: PECS-116**

CO#	Statements
CO1	Outline basic terminology and components in information retrieval systems.
CO2	. understand the issues involved in providing an ir service on a web scale
CO3	Compare and contrast information retrieval models and internal mechanisms
CO4	Evaluate information retrieval algorithms and give an account of the difficulties of evaluation.
CO5	Identify and analyze the various aspects of a specific problem and apply the concepts of information retrieval to develop a model.
CO6	Develop the ability to develop a complete ir system from scratch.

Course Name: System Programming **Course Code: PECS-125**

CO#	Statements
CO1	Understand the relationship between system software and machine architecture.
CO2	Study the architecture of a hypothetical machine, its assembly language and macro language.
CO3	Identify the need and implementation of macro processor, linkers and loaders.
CO4	Determine the basics of compiler design and their applications in programming language.
CO5	Analyze the process of scanning and parsing techniques.
CO6	Identify the most common pitfalls of code using debuggers and be able to locate, analyze, and fix the errors.

Course Name: Artificial Intelligence Laboratory **Course Code: LPCCS-106**

CO#	Statements
CO1	Design and implement efficient uninformed search techniques to solve problems.
CO2	Apply the knowledge of different informed search to identify and implement the appropriate techniques in problem solving.
CO3	Utilize knowledge and techniques of game playing to develop single player game.
CO4	Handle uncertainty by designing the bayesian network and inferring from the given data.
CO5	Utilize the knowledge and techniques of artificial intelligence while working in multidisciplinary teams.
CO6	Design and develop projects using artificial intelligence tools and techniques.

Course Name: Database Management System Laboratory **Course Code: LPCCS-107**

CO#	Statements
CO1	Understand, analyze and apply common sql statements including ddl, dml and dcl statements to perform different operations.
CO2	Design different views of tables for different users and to apply embedded and nested queries.
CO3	Design and implement a database for a given problem according to well known design principles that balance data retrieval performance with data consistency.
CO4	Demonstrate and understand relational algebra in database which is helpful to design related database software components.
CO5	Identify the user requirements from a typical business situation, and to document them.
CO6	Emphasize on team work and developing database applications using modern database tools

Course Name: Design and Analysis of Algorithms Laboratory Course Code: LPCCS-108

CO#	Statements
CO1	Construct algorithms using basic design techniques for searching, sorting and graph algorithms
CO2	Design algorithm using advanced techniques for solving complex problems
CO3	Identify the given problem and formulate and design algorithm for solving given problem.
CO4	Use modern engineering tools and latest programming language to implement the designed algorithms.
CO5	Apply knowledge and function on multi-disciplinary teams through mini projects based on various problems
CO6	Analyze the performance of various algorithms to choose the optimum algorithm

Course Name: Institutional Training Course Code: TR-102

CO#	Statements
CO1	Participate in the industrial projects in challenging environment of industry.
CO2	Describe use of advanced tools and techniques encountered in industrial environment.
CO3	Interact with professional and follow engineering practices and discipline required for real time projects.
CO4	Develop awareness about general workplace behaviour and build interpersonal and team skills.
CO5	Prepare project modules, professional work reports and presentations.
CO6	Design and develop software solutions as per requirements and satisfaction of clients.

Course Name: Compiler Design **Course Code: PCCS-112**

CO#	Statements
CO1	Apply knowledge of system programming and mathematics to solve problems related to language translation
CO2	Identify, formulate and solve engineering problems in the area of language translation and compiler design.
CO3	Formulate machine code by considering the system design components and functionalities involved in compilation.
CO4	Inspect runtime structure used to represent constructs of programming language during compilation process.
CO5	Use of compiler phases to develop an understanding of their use in building tools used for engineering practice.
CO6	Developing an awareness of the functionality and complexity of modern compilers to engage in independent and life-long learning in the broadest context of technological change.

Course Name: Computer Graphics **Course Code: PCCS-113**

CO#	Statements
CO1	Apply the concepts of mathematical foundations and programming to solve diverse problems related to computer graphics.
CO2	Compare and contrast various computer graphic algorithms and their suitability to real world problems.
CO3	Utilize models for transformation of 2d and 3d objects.
CO4	Identify the areas of computer graphics to apply advance algorithmic techniques for changing the formations of geometrical objects.
CO5	Apply mathematics and physics in the design and development of graphics applications.
CO6	Justify the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Course Name: Machine Learning **Course Code: PCCS-114**

CO#	Statements
CO1	Implement probability concepts in learning problems with hypothesis and version spaces
CO2	Illustrate the features and algorithms of machine learning with real world problems
CO3	Differentiate between machine learning algorithms as supervised learning and unsupervised learning and, interpret the results with graphs and tables
CO4	Demonstrate concept of neural networks for learning linear and non-linear activation functions
CO5	Apply the concepts of bayesian analysis from probability models and methods
CO6	Explain and design genetic algorithms for engineering problems with their analysis using evaluation measures

Course Name: Cyber Security **Course Code: PCCS-115**

CO#	Statements
CO1	Analyze and illustrate the security policies, as well as protocols to implement security features.
CO2	Analyze the network and system attacks, defences against them.
CO3	Incorporate the approaches for risk management and needful practices.
CO4	Classify the principles of web security.
CO5	Determine computers networks and examine secure software practices.
CO6	Design key terms and concepts in cyber security, protect intellectual property and decrease cyber-crimes.

Course Name: Software Testing and Quality Assurance Course Code: PECS-102

CO#	Statements
CO1	Test the software by applying testing techniques to deliver a product free from bugs.
CO2	Investigate the scenario and to select the proper testing technique.
CO3	Explore the test automation concepts and tools and estimation of cost, schedule based on standard metrics.
CO4	Test the software by applying testing techniques to deliver a product free from bugs.
CO5	Test the software by applying testing techniques to deliver a product free from bugs.
CO6	Ability to conduct formal inspections, record and evaluate results of inspections.

Course Name: Network Security and Cryptography Course Code: PECS-108

CO#	Statements
CO1	Apply the knowledge of existing authentication protocols and key management techniques to provide security solutions
CO2	Identify and analyze network security attacks and counter measures to prevent those attacks.
CO3	Evaluate network security models using available solutions such as pgp, ssl, ipsec to provide robust framework for security threats.
CO4	Assess impact of system and web security threats to ensure secure transmission of data.
CO5	Analyze the security requirements and solutions for maintaining data integrity using modern techniques for data transmission.
CO6	Testing and verification of cryptography aspects by integrating people, processes and technologies.

Course Name: Advance Database Management System **Course Code: PECS-114**

CO#	Statements
CO1	Implement pl/sql programming using concept of cursor management, error handling, package and triggers. (change from level-2 to level 3 or above)
CO2	Apply and relate the concept of transaction, concurrency control and recovery in database.
CO3	Recognize the purpose of query processing and optimization and also demonstrate the basic of query evaluation.
CO4	Illustrate the concept of object oriented database and have experience with object oriented modeling, design and implementation. (change from level-2 to level 3 or above)
CO5	List the principles of distributed systems and describe the problems and challenges associated with these principles.
CO6	Evaluate the association rules for mining the data

Course Name: Natural Language Processing **Course Code: PECS-120**

CO#	Statements
CO1	Apply the knowledge of engineering to understand the computational properties of natural languages and to implement the algorithms for processing linguistic information.
CO2	Utilize the models and methods of statistical natural language processing for common nlp tasks such as speech recognition, machine translation, text classification, spell checking etc.
CO3	Understand the key concepts of morphology, syntactic analysis for implementing pos tagging algorithms and context free grammar for English language.
CO4	Identify and apply natural language processing algorithms to solve real world problems
CO5	Understanding semantics and pragmatics of English language for processing.
CO6	Implement, and apply state-of-the-art techniques to novel problems involving natural language data.

Course Name: Java Programming **Course Code: PECS-126**

CO#	Statements
CO1	Apply object oriented programming techniques to propose solution pertaining to real world problems.
CO2	Identify and analyze the various aspects of a specific problem and apply the concepts of classes and objects to develop object oriented model.
CO3	Utilize the concept of inheritance and polymorphism to formulate a solution for complex analytical problem.
CO4	Examine the errors in the developed system and resolve them by applying the knowledge of exception handling.
CO5	Design console based, GUI based and web based applications by implementing various concepts like event handling, applets and database connectivity.
CO6	Utilize the concept of networking to develop systems for establishing communication between client and server.

Course Name: Computer Graphics Laboratory **Course Code: LPCCS-109**

CO#	Statements
CO1	Apply mathematics and logic to develop computer programs for elementary graphic operations.
CO2	Implement scan conversion problems using a programming language.
CO3	Outline the concepts of different type of geometric transformation of objects in 2d and 3d
CO4	Implement clipping and filling techniques for modifying an object.
CO5	Gain experience in creating interactive graphics applications using one or more graphics application programming interfaces.
CO6	Develop scientific and strategic approach to solve complex problems in the domain of computer graphics.

Course Name: Machine Learning Laboratory **Course Code: LPCCS-110**

CO#	Statements
CO1	Develop, analyze and visualize the implementation of machine learning algorithms
CO2	Design and develop various algorithms for specific problems with appropriate datasets
CO3	Analyze and identify the need for machine learning techniques for specific domain
CO4	Develop solutions of real time problems with the prediction and visualization
CO5	Apply and analyze genetic algorithms for optimization of engineering solutions
CO6	Develop and analyze algorithms for optimization of engineering solutions

Course Name: Software Testing and Quality Assurance Laboratory **Course Code: LPECS-101**

CO#	Statements
CO1	Ability to conduct formal inspections, record and evaluate results of inspections.
CO2	Adapt to various test processes, types of errors and fault models and methods of test generation from requirements for continuous quality improvement of the software system along with Software Quality best practices usage.
CO3	Apply software testing cycle in relation to software development and project management focusing incidents.
CO4	Apply risks management within a project towards efficient delivery of software solutions.
CO5	Implement improvements in the software development processes by making use of standards and baselines
CO6	Test the software by applying testing techniques to deliver a product free from bugs.

Course Name: Network Security and Cryptography Laboratory Course Code: LPECS-104

CO#	Statements
CO1	Implement encryption and decryption techniques for providing security solutions.
CO2	Analyze the impact of public key cryptosystems for secure exchange of information.
CO3	Analyze and design network security protocols for information exchange over unsecure network
CO4	Apply security principles for implementing authentication applications.
CO5	Analyze the security requirements and solutions for maintaining data integrity using modern techniques for data transmission.
CO6	Testing and verification of cryptography aspects by integrating people, processes and technologies.

Course Name: Advance Database Management System Lab. **Course Code: LPECS-107**

CO#	Statements
CO1	Implement pl/sql programming using concept of cursor management, error handling, package and triggers. (change from level-2 to level 3 or above)
CO2	Apply and relate the concept of transaction, concurrency control and recovery in database.
CO3	Recognize the purpose of query processing and optimization and also demonstrate the basic of query evaluation.
CO4	Illustrate the concept of object oriented database and have experience with object oriented modeling, design and implementation. (change from level-2 to level 3 or above)
CO5	List the principles of distributed systems and describe the problems and challenges associated with these principles.
CO6	Evaluate the association rules for mining the data.

Course Name: Natural Language Processing Laboratory **Course Code: LPECS-110**

CO#	Statements
CO1	Apply the knowledge of engineering to understand the computational properties of natural languages and to implement the algorithms for processing linguistic information.
CO2	Utilize the models and methods of statistical natural language processing for common NLP tasks such as speech recognition, machine translation, text classification, spell checking etc.
CO3	Understand the key concepts of morphology, syntactic analysis for implementing pos tagging algorithms and context free grammar for English language.
CO4	Identify and apply natural language processing algorithms to solve real world problems
CO5	Understanding semantics and pragmatics of English language for processing.
CO6	Implement, and apply state-of-the-art techniques to novel problems involving natural language data.

Course Name: Java Programming Laboratory **Course Code: LPECS-113**

CO#	Statements
CO1	Apply the knowledge of JAVA language syntax and semantics to write and execute Java programs.
CO2	Create Java programs based on object oriented principles like classes, objects, constructors and inheritance.
CO3	Implement the concept of applets and event handling with development of GUI interfaces for a computer program to interact with users and event based GUI handling principles.
CO4	Implement exception handling techniques to make the system bug free.
CO5	Apply the knowledge of event handling, applets, networking features and database connectivity to develop business oriented web based solution.
CO6	Design Java programs to design a system to meet industrial needs and to solve real world problems based on client-server communication.

Course Name: Minor Project **Course Code: PRCS-102**

CO#	Statements
CO1	Apply engineering, ethical and mathematical principles to achieve objectives of a project.
CO2	Analyze, formulate and review the literature and develop solutions for framed problem statement.
CO3	Design and construct hardware and/or software system, component, or process to meet desired needs.
CO4	Choose and apply emerging trends and contemporary project management methodologies in context of computer science and engineering.
CO5	Test and validate various modules of planned project.
CO6	Demonstrate the ability to work, communicate effectively as a team and to write and present technical reports.

Course Name: Agile Software Development **Course Code: PECS-103**

CO#	Statements
CO1	Interpret the concept of agile software engineering and its advantages in software development.
CO2	Analyze the core practices behind several specific agile methodologies.
CO3	Identify the roles and responsibilities in agile projects and their difference from projects following traditional methodologies.
CO4	Access implications of functional testing, unit testing, and continuous integration.
CO5	Determine the role of design principles in agile software design.
CO6	Make use of various tools available to agile teams to facilitate the project.

Course Name: Object Oriented Analysis and Design Using UML Course Code: PECS-104

CO#	Statements
CO1	Identify and apply various software diagrams, to determine the quality level of software.
CO2	Effective Quality control and reliability of quality process and Quality management system Models
CO3	Identify the quality level of internal and external attributes of the software product to be designed.
CO4	Work with various methods, metrics and strategies for Testing software projects.
CO5	Design various diagrams considered as reliability models for evaluating the quality level of the software based on the requirement.
CO6	Evaluate a design for applicability and relation to other design criteria.

Course Name: Object Oriented Analysis and Design Using UML Laboratory

Course Code: LPECS-102

CO#	Statements
CO1	Identify various metrics and models to Access software
CO2	Identify the suitable project organization structure, leadership, decision and motivation styles, safety and ethical practices and be responsible to the society.
CO3	Identify the usage of various activity scheduling tools.
CO4	Understand the phases of software projects and practice the activities of each phase.
CO5	Apply schedule and cost control techniques for project monitoring including contract management.
CO6	Perform Analysis and Design activities using Object oriented modeling techniques.

Course Name: Software Defined Networks **Course Code: PECS-109**

CO#	**Statements**
CO1	Learn the concepts of software defined networks and differentiate from traditional networks.
CO2	Examine the SDN architecture and operation of SDN.
CO3	Learn SDN interface between networking devices and the software controlling them.
CO4	Describe Network Functions Virtualization components and their roles in SDN.
CO5	Understand Open Flow specifications and key benefits of SDN by the separation of data, control planes and application plane.
CO6	Examine the needs of SDN data center and various technologies and use cases in SDN.

Course Name: Wireless Sensor Networks **Course Code: PECS-110**

CO#	Statements
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks.
CO2	Study the various protocols at various layers and its differences with traditional protocols
CO3	Identify the issues pertaining to sensor networks and the challenges involved in managing sensor networks.
CO4	Understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
CO5	Design and apply suitable routing algorithm based on the network and user requirement.
CO6	Apply the knowledge to identify appropriate physical and MAC layer protocols.

Course Name: Wireless Sensor Networks laboratory **Course Code: LPECS-105**

CO#	Statements
CO1	Know the basics of ad hoc networks and wireless sensor networks.
CO2	Study the various protocols at various layers and its differences with traditional protocols.
CO3	Identify the issues pertaining to sensor networks and the challenges involved in managing sensor networks.
CO4	Understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
CO5	Design and apply suitable routing algorithm based on the network and user requirement.
CO6	Apply the knowledge to identify appropriate physical and mac layer protocols.

Course Name: Data Warehousing and Data Mining **Course Code: PECS-115**

CO#	Statements
CO1	Analyze the evolutionary path that has led to the purpose of adapting to Data Warehouse and Data Mining techniques in various domains
CO2	Identify the need of Data Warehouse tools and techniques.
CO3	Evaluate different Data Mining techniques to gather and analyze large sets of data to gain useful business understanding
CO4	Describe basic Data Mining algorithms, methods and tools
CO5	Compare different approaches of Data Warehousing and Data Mining with various technologies
CO6	Examine prescribed case studies and identify the patterns of developing areas of Data Mining

Course Name: Cloud Computing **Course Code: PECS-117**

CO#	Statements
CO1	Compare and contrast the different computing paradigms
CO2	Make use of core technologies of cloud computing in selection of cloud deployment model.
CO3	Classify the various service models of cloud.
CO4	Access the various issues and challenges in context of cloud security.
CO5	Compare and contrast open cloud platforms with commercial cloud platforms.
CO6	Plan a cloud using open cloud platform.

Course Name: Cloud Computing Laboratory **Course Code: LPECS-108**

CO#	Statements
CO1	Make use of CloudSim toolkit for performing different experiments
CO2	Apply Cloud Analyst simulation tool to perform various tasks.
CO3	Compare and contrast the various cloud simulation tools.
CO4	Access the performance of cloud computing application.
CO5	Develop and embed scheduling policy in cloud simulation tools.
CO6	Examine the architecture and services offered by different cloud platforms.

Course Name: Computer Vision **Course Code: PECS-121**

CO#	Statements
CO1	Identify basic terminology, theories and models in the field of Computer Vision.
CO2	Analyze different methods of Computer Vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
CO3	Use and apply appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation.
CO4	Access which methods to use for solving a given problem, and analyze the accuracy of the methods.
CO5	Design Computer Vision system for a specific problem.
CO6	Construct the geometric relationships between 2D images and the 3D world.

Course Name: Soft Computing **Course Code: PECS-122**

CO#	Statements
CO1	Analyze the behavioral aspects of various soft computing techniques.
CO2	Implement the concept of genetic algorithms to develop various genetic applications.
CO3	Describe the operational benefits of neural network architectures and Fuzzy logic.
CO4	Identify and Apply a suitable Soft Computing technology to solve the problem.
CO5	Construct optimized solution for various Fuzzy Systems.
CO6	Demonstrate and Apply various optimization techniques to solve a real world problem.

Course Name: Soft Computing Laboratory **Course Code: LPECS-111**

CO#	Statements
CO1	Design and Implement efficient Soft Computing techniques to solve real world problems.
CO2	Utilize knowledge of genetic algorithmic concepts to build their applications.
CO3	Construct solutions to various Fuzzy and Neural Networks
CO4	Identify a suitable Soft Computing technology to solve the problem.
CO5	Develop projects using soft computing tools and techniques.
CO6	Construct optimized solution for various Fuzzy Systems

Course Name: Advanced Algorithm Design and Analysis **Course Code: PECS-127**

CO#	Statements
CO1	Compare and analyze different design techniques with an intent of their limitations and benefits.
CO2	Design optimal solution for complex engineering problems using advance algorithms design techniques.
CO3	Analyze various solution of complex engineering problems using different algorithm design techniques.
CO4	Make use of research based knowledge and research methods to find out the optimal algorithm for the solution of real life problems.
CO5	Design solution of complex engineering problems in the framework of parallel computing to reduce time complexity.
CO6	Apply algorithmic principles and computer science theory to the modeling and design of computer based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

Course Name: Web Technologies **Course Code: PECS-128**

CO#	Statements
CO1	Apply the knowledge of web technology stack to deploy various web services.
CO2	Analyze and evaluate web technology components for formulating web related problems
CO3	Design and develop website using HTML, CSS, JavaScript and PHP
CO4	Implement the concept of Session and Cookies for Login System
CO5	Apply advance concepts of web APIs to build web projects in multidisciplinary environments.
CO6	Implement the concept for creating content based dynamic web applications.

Course Name: Web Technologies Laboratory **Course Code: LPECS-114**

CO#	Statements
CO1	Develop a Dynamic webpage by the use of HTML, CSS, PHP and JavaScript
CO2	Analyze a web page and identify its elements and attributes.
CO3	Build dynamic web pages using MVC Environment
CO4	Create Responsive Website Design by using the Twitter Bootstrap
CO5	Understanding of server side scripting with PHP language
CO6	Develop and deploy real time web applications on web servers

Course Name: Technical Aptitude **Course Code: PRCS-106**

CO#	Statements
CO1	To apply Technical expertise in design, coding and testing principles in software systems development projects.
CO2	To identify and use technical and analytical thinking to model the research based problems and solve them.
CO3	To understand the use of technical aptitude in all the aspects of career and prepare for them accordingly.
CO4	To solve different types of questions based on Core areas of Computer Science and Engineering.
CO5	To speak fluently and confidently to demonstrate various techniques during presentations.
CO6	To demonstrate corporate readiness in terms of attitude, communication, team work and emotional balance

Course Name: Training-III **Course Code: TR-103**

CO#	Statements
CO1	Acquire the basic skills about project development, organization and implementation to provide solution for a problem.
CO2	Gain first-hand experience of working as an engineering professional and technical application of engineering knowledge.
CO3	Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
CO4	Learn modern tools and contemporary ideas by practicing self-learning.
CO5	Learn work ethics by interacting with engineers and other professional groups thereby, increasing technical, interpersonal and communication skills.
CO6	Writing technical reports, demonstrate and presenting their projects.

Course Name: Industrial Training **Course Code: TR-104**

CO#	Statements
CO1	Improve their ability to solve problems utilizing the tools and available industrial environment.
C02	Understand the professional responsibility, duty and ethics of an engineer.
CO3	Get familiar with real-world working conditions and procedures, to develop professionalism and team-work capabilities.
CO4	Learn the fundamentals of project creation, feasibility analysis, and implementation in order to create a cost-effective solution for interdisciplinary domains.
CO5	Understand the many difficulties encountered in the actual world and the important issues calling for more research considering the societal needs.
C06	Develop engineering communication skills, such as those for technical writing and speaking up in the workplace.

Course Name: Software Metrics **Course Code: PECS-105**

CO#	Statements
CO1	Identify and apply various software metrics, which determines the quality level of software
CO2	Access quality control and reliability of quality process and quality management system models.
CO3	Identify and evaluate the quality level of internal and external attributes of the software product.
CO4	Work with various techniques, metrics and strategies for Testing software projects.
CO5	Design new metrics and reliability models for evaluating the quality level of the software based on the requirement.
CO6	Control and manage the project and processes, apply configuration management on the basis of collected metrics.

Course Name: Component Based Development **Course Code: PECS-107**

CO#	Statements
CO1	To Familiarize with Component Based Systems, their Purpose and Scope
CO2	Analyze Software Engineering Practices related to CBD
CO3	Apply design Of Software Component Infrastructures
CO4	Identify Component Based Development Technologies
CO5	Deal with Fundamental properties of components, technology and architecture and middleware
CO6	Relate the concept of Legal and regulatory framework related to Component Based Development

Course Name: Component Based Development Laboratory **Course Code: LPECS-103**

CO#	Statements
CO1	To Familiarize with Component Based Systems, their Purpose and Scope
CO2	Analyze Software Engineering Practices related to CBD.
CO3	Apply design Of Software Component Infrastructures.
CO4	Identify Component Based Development Technologies
CO5	Deal with Fundamental properties of components, technology and architecture and middleware.
CO6	Relate the concept of Legal and Regulatory framework related to Component Based Development.

Course Name: Blockchain Technology **Course Code: PECS-113**

CO#	Statements
CO1	Elaborate the emerging concept of Blockchain Technology as a foundation for future.
CO2	Outline the secure interaction mechanism within a blockchain system.
CO3	Discuss various consensus algorithms used in blockchain system.
CO4	Demonstrate Ethereum network and understand smart contracts.
CO5	Explain the hyperledger fabric and deal with digital ledgers.
CO6	Analyze various research areas in blockchain technology.

Course Name: Internet of Things **Course Code: PECS-112**

CO#	Statements
CO1	Understand general concepts of internet of things (iot).
CO2	Discriminate the functionality of ip and mac addresses along-with the application layer protocols.
CO3	Illustration of the design principles for connected devices and web connectivity.
CO4	Analyze various m2m and iot architectures.
CO5	Apply design concepts to iot solutions.
CO6	Create iot solutions using sensors, actuators, and devices.

Course Name: Internet of Things laboratory **Course Code: LPECS-106**

CO#	Statements
CO1	Understand internet of things along-with its hardware and software components.
CO2	Interface i/o devices, sensors & communication modules.
CO3	Use wireless peripherals for exchange of data.
CO4	Understand the key features of ad hoc and sensor networks
CO5	Analyze and evaluate protocols used in iot and data received through sensors in iot.
CO6	Develop real-time iot based automation systems.

Course Name: Big Data **Course Code: PECS-118**

CO#	Statements
CO1	Explain the structural concepts and analytics tools of big data related with business problems.
CO2	Apply Hadoop and MapReduce commands in big data distributed Environment of Clusters.
CO3	Evaluate Hadoop distributed file system with Mapper and Reducer for big data management.
CO4	Discuss and compare different types of databases for big data application management.
CO5	Classify business analytics and analytical methods in practice for decision making in businesses.
CO6	Examine and utilize different analytical methods and case studies for the analysis of big data problems in contemporary businesses.

Course Name: Data Science **Course Code: PECS-119**

CO#	Statements
CO1	Analyze the need and usage of various facets of data.
CO2	Examine the steps for Data collection and Data Science process.
CO3	Identify and apply various forms of representing data.
CO4	Perform exploratory data analysis.
CO5	Understand and apply various visualization techniques.
CO6	Demonstrate and enrich knowledge for various model validation techniques.

Course Name: Data Science Laboratory **Course Code: LPECS-109**

CO#	Statements
CO1	Understand concepts of R programming.
CO2	Understand and demonstrate use of variables, data types and operations using R.
CO3	Perform and use various mathematical constructs for better analysis of data
CO4	Implement various visualization techniques for gaining more data insights.
CO5	Utilize the knowledge and techniques of Data Science for having more information gain form
CO6	Design and develop projects using Data Science tools and techniques

Course Name: Human Computer Interaction **Course Code: PECS-123**

CO#	Statements
CO1	Examine the capabilities of both humans and computers from the viewpoint of human information processing.
CO2	Create the structure of human computer interaction models.
CO3	Apply an interactive design process and universal design principles to design HCI systems
CO4	Depict and use HCI design principles, standards and guidelines.
CO5	Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.
CO6	Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.

Course Name: Deep Learning **Course Code: PECS-124**

CO#	Statements
CO1	Understand the concept of Deep Learning, types of learning and computational units.
CO2	Compare and analyze new optimization methods for neural networks, feed forward networks, Recurrent neural networks, Convolutional Neural Networks, Autoencoders and Boltzmann Machines
CO3	Learn deep learning methods for working with sequential data, deep recurrent and memory networks.
CO4	Identify, formulate and analyze uses and Constraints of various Convolutional Neural Networks.
CO5	Know the open issues in deep learning and have a grasp of the current research directions.
CO6	Apply deep learning mechanisms to various learning problems.

Course Name: Deep Learning Laboratory **Course Code: LPECS-112**

CO#	Statements
CO1	Implement deep learning algorithms, understand neural networks and traverse the layers of data abstraction which will empower to understand data more precisely.
CO2	Learn topics such as convolutional neural networks, recurrent neural networks, training and high-level interfaces
CO3	Troubleshoot and improve deep learning models
CO4	Performing experiments in Deep Learning using real-world data
CO5	Design the test procedures to Access the efficacy of the developed model.
CO6	Apply deep learning mechanisms to various learning problems.

Course Name: Parallel and Distributed Algorithms **Course Code: PECS-129**

CO#	Statements
CO1	Understand and learn parallel and distributed algorithms development techniques for shared memory and message passing models
CO2	Study the main classes of parallel algorithms.
CO3	Analyze the complexity and correctness models for parallel algorithms.
CO4	Apply techniques and methods to design efficient parallel and distributed algorithms
CO5	Understand the concepts and issues related to distributed systems.
CO6	Manage performance, reliability and other issues while designing in distributed environment

Course Name: Mobile Application Development **Course Code: PECS-130**

CO#	Statements
CO1	Demonstrate the android features and develop application using Android.
CO2	Utilize rapid prototyping techniques to design and develop sophisticated mobile Interfaces.
CO3	Design and develop mobile application that accommodates user specific requirements and constraints analysis.
CO4	Understand the basic principles of Mobile Application to develop different applications.
CO5	Program mobile applications for the Android operating system that use basic and advanced phone features.
CO6	Implement the concept for creating Hybrid Mobile Application using React Native.

Course Name: Mobile Application Development Laboratory **Course Code: LPECS-115**

CO#	Statements
CO1	Understand the basic principles of Mobile application development
CO2	Build a native application using GUI components and Mobile application development framework
CO3	Develop an application using basic graphical primitives and databases
CO4	Construct an application using multi-threading and RSS feed
CO5	Make use of location identification using GPS in an application
CO6	Model new applications to handheld devices

Course Name: Major Project **Course Code: PRCS-103**

CO#	Statements
CO1	Apply engineering, ethical and mathematical principles to achieve objectives of a project.
CO2	Analyze, formulate and review the literature and develop solutions for framed problem statement.
CO3	Design and construct hardware and/or software system, component, or process to meet desired needs.
CO4	Choose and apply emerging trends and contemporary project management methodologies in context of computer science and engineering.
CO5	Test and validate various modules of planned project.
CO6	Demonstrate the ability to work, communicate effectively as a team and to write and present technical reports.

Course Name: Software Management Tools **Course Code: PRCS-107**

CO#	Statements
CO1	Apply knowledge for the management of various software.
CO2	Recognize the benefits of software planning and configuration management tools.
CO3	Explore various software management tools for throughout evaluation of the software projects.
CO4	Analyze various software management tools along with their components for project planning and designing purpose.
CO5	Implement various CICD tools and techniques for effective application of relevant standards for project management.
CO6	Identify the benefits of various tools for software debugging, UML Diagrams and various project charts