PG DEPARTMENT OF COMPUTER SCIENCE

OUTCOME BASED SYLLABUS

PCCSB20 - .NET FRAMEWORK

Year: I **Sem:** I	**Course Code:** PCCSB20	**Title of the Course:** .Net Framework	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**Credits** 5	**Marks** 100

Course Objectives

1. This course presents the practical aspects of application development using .Net framework.
2. It also covers the Common Language Runtime (CLR), .Net framework classes, C#, and ADO.NET
3. To update and enhance skills in writing Windows applications, ADO.NET and ASP.NET.
4. The student will gain programming skills in C# both in basic and advanced levels.
5. By building sample applications, the student will get experience and be ready for large - scale projects.

Course Outcomes (COs)

1. Understand code solutions and compile C# projects within the .NET Framework.
2. Develop C# console applications using Classes and Objects and Interfaces.
3. Design and Implement database connectivity using ADO.NET in Windows Based Applications.
4. To understand and be able to using XML in C#.NET specifically ADO.NET and SQL server.
5. Develop the Web Applications using C#.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	L	M	H	M	L	L
CO2	L	L	H	M	L	M
CO3	L	M	L	M	L	L
CO4	L	M	L	H	M	M
CO5	H	L	H	M	M	L

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I **(18 Hours)**

1.1 Introducing C# - .NET Framework - The C# Language (K1)
1.2 Variables and Data - Operators (K1, K2)
1.3 Control Structures (K3)
1.4 C# Array - ArrayList Class (K5)
1.5 String - StringBuilder Class (K3, K4)
1.6 Functions and Methods – Structures (K3, K6)

Unit II **(16 Hours)**

2.1 Classes and Objects - Constructor and Destructors (K1, K2)
2.2 Types of Classes - Various Class Members (K2)
2.3 Interfaces - Delegates - Events (K4, K6)
2.4 Inheritance - Access Modifiers - Class Modifiers (K3, K4)
2.5 Polymorphism - Operator Overloading - Errors and Exceptions (K5)
2.6 C# Files and IO - C# Collections. (K5, K6)

Unit III **(14 Hours)**

3.1 ADO.NET: C# Graphical User Interface and Application Development (K2, K3)
3.2 .Net Environment - User Interface Elements and Hierarchy in C# (K4)

3.3 Programming with the Windows Controls (K5)
3.4 C# MDI Form - Dialog Box (K4, K5)
3.5 C# ADO.Net: Data Providers - ADO.NET Objects (K3)
3.6 Data Set - Working with Data.(K6)

Unit IV **(15 Hours)**

4.1 XML.Net: XML-A Brief Introduction - XML Syntax (K1)
4.2 Reading and Writing XML Files - Searching XML File using XPATH (K1, K2)
4.3 XML and ADO.NET for Handling Data (K6)
4.4 Fundamentals of Web Programming - ASP.NET Life Cycle (K2, K5)
4.5 ASP.NET Applications and Configuration - Web Forms (K4)
4.6 SOAP and Web Services - Creating and Consuming Web Service.(K5, K6)

Unit V **(12 Hours)**

5.1 .Net Assemblies: Integrating Application Files (K2)
5.2 Security in .NET - Attributes (K2, K4)
5.3 Reflections - Type Discovery (K3)
5.4 Remote Programming: C# Remoting Architecture (K2, K6)
5.5 Domains - Contexts - Proxies (K2, K5)
5.6 Marshalling and Unmarshalling(K3)

Text Books:

1. AnamitraDeshmukh–Nimbalkar (2018). C# and .Net Programming. Technical Publications. First Edition.

Reference Books:

1. Christian Nageletal (2012). Professional C# 2012 with .NET 4.5. Wiley India.
2. Herbert Schildt (2012). The Complete Reference: C# 4.0. Tata McGraw Hill.
3. Andrew Troelsen (2010). Pro C# 2010 and the .NET 4 Platform. Fifth Edition.
4. Ian Griffiths- Matthew Adams- Jesse Liberty (2010). Programming C# 4.0. Sixth Edition. O'Reilly.

Open Educational Resources (OER):

1. https://www.w3schools.com/cs/

https://www.youtube.com/watch?v=GcFJjpMFJvI&t=759s

PECSA20 – ELECTIVE I A: DESIGN AND ANALYSIS OF ALGORITHM

Year: I **Sem:** I	**Course Code:** PECSA20	**Title of the Course:** Elective I A: Design and Analysis of Algorithm	**Course Type:** Theory	**Course Category:** Elective	**H/W** 5	**Credits** 5	**Marks** 100

Course Objectives

1. To develop skills in design and implementation of data structures and their applications.
2. To understand the usage of graph structures and spanning trees.
3. To acquire the knowledge of using advanced tree structures.
4. To learn the usage of heap structures.
5. To explain classification of problems based on the computational complexity

Course Outcomes (COs)

1. Understand data structures and the concepts of algorithm for Merge Sort, Quick Sort and Binary Search.
2. Understand the fundamental graph algorithms in solving optimization problems.
3. Update knowledge to learn advanced tree concepts in data structure and algorithm.
4. Able to perform all the operations on Hashing and Heaps.
5. Analyze the computational complexity of various algorithms.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	L	M	H	M	L	M
CO2	M	H	L	L	M	L
CO3	H	M	L	M	L	M
CO4	M	H	M	L	M	L
CO5	L	M	M	L	M	L

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I **(15 Hours)**

1.1 Introduction: Fundamentals of algorithmic problem solving (K1)
1.2 Asymptotic notations (K2)
1.3 Mathematical Analysis for Recursive and Non-Recursive Algorithms (K1, K3)
1.4 External Sorting: k-way Merge Sort (K5, K6)
1.5 Quick Sort – Binary Search (K4, K5)
1.6 Strassen's Matrix Multiplication (K3, K6)

Unit II **(15 Hours)**

2.1 Graphs: Graph Terminology – Directed Graphs – Representation of Graphs (K1)
2.2 Graph Traversal Algorithms – Topological Sorting (K1, K2, K6)
2.3 Minimum Spanning Trees: Kruskal's Algorithm (K4, K5, K6)
2.4 Prim's Algorithm (K4, K5)
2.5 Shortest Path Algorithms: Dijkstra's Algorithm (K3, K4, K6)
2.6 Warshall's Algorithm – Floyd's Algorithm (K4, K5, K6)

Unit III **(15 Hours)**

3.1 Trees: Basic Terminology – Types of Trees (K1, K2)
3.2 Creating a Binary Tree from a General Tree – Traversing a Binary Tree(K2, K3)
3.3 Efficient Binary Search Trees: Binary Search Trees (K3, K6)

3.4 Optimal Binary Search Tree (OBST) – AVL Trees (K1, K5)
3.5 Multi-way Search Trees: M-way Search Trees (K1, K4)
3.6 B-Trees - B+ Trees (K3, K6)

Unit IV **(15 Hours)**

4.1 Hashing: Introduction to Static Hashing – Hash Tables (K1, K2)
4.2 Different Hash Functions – Secure Hash Functions Dynamic Hashing (K2)
4.3 Priority Queues (Heaps): Binary Heaps – Basic Heap Operations (K2, K6)
4.4 Applications of Priority Queues (K2, K4)
4.5 Binomial Heaps Structure and Implementation – Binomial Queue Operations (K5)
4.6 Comparison between Binary and Binary Heaps**(**K1, K3)

Unit V **(15 Hours)**

5.1 Backtracking: N-Queens problem – Hamiltonian Circuit Problem (K2)
5.2 Subset-Sum Problem – Branch and Bound(K3, K4)
5.3 Assignment Problem (K4, K6)
5.4 Knapsack Problem (K4, K5, K6)
5.5 Travelling Salesman Problem (K2, K5)
5.6 P & NP Problems – NP-Complete Problems (K3, K4)

Text Books:

1. ReemaThareja, S. Rama Sree (2018), "Advanced Data Structure", Oxford University Press.

Reference Books:

1. J. LalithaVani, T. PriyaRadhika Devi (2015). Design and Analysis of Algorithms. First Edition.
2. AnanyLevitin (2011). Introduction to the Design and Analysis of Algorithms. Edition III, Addison-Wesley.
3. Thomas H. Carmen, Charles Eric Leiserson, Ronald L. Rivest, Clifford Stein (2009). Introduction to Algorithms. Edition III - MIT Press.

Open Educational Resources (OER):

1. https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLGdMwVKbjVQ8Ew7KUp65sRL9_k2_3xlKE
2. https://nptel.ac.in/courses/106/106/106106131/

PCCSI20 – THEORY OF COMPUTATION

Year: I Sem: II	Course Code: PCCSI20	Title of the Course: Theory of Computation	Course Type: Theory	Course Category: Core	H/W 5	Credits 4	Marks 100

Course Objectives

1. To understand the concepts and operations of matrix algebra needed for computing graphics modeling.
2. To understand and apply the class of functions which transform a finite set into another finite set which relates to input output functions in computer science.
3. To impart discrete knowledge in computer engineering through finite automata and Context free grammars.
4. To develop methods by which computer scientists can describe and analyze the dynamic behavior of discrete systems, in which signals are sampled periodically.
5. To enhance student's ability to understand and conduct mathematical proofs for computation and algorithms.

Course Outcomes (COs)

1. Understand and conduct mathematical proofs for computation and algorithms.
2. Show a competent understanding of the basic concepts of graph theory.
3. Explain the models of computation, including formal languages, grammars and automata.
4. Recognize and comprehend formal reasoning about languages.
5. Expand knowledge of pushdown automata and Turing machines.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	L	M	M	H	L	H
CO2	L	H	M	M	M	H
CO3	H	L	M	H	M	M
CO4	L	M	H	M	L	H
CO5	L	M	L	H	M	L

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I **(13 Hours)**

1.1 Logic and Propositional Calculus: Introduction- Propositions and Compound Propositions (K1)
1.2 Basic Logical Operations – Tautologies and Contradictions – Logical Equivalence (K1, K2)
1.3 Algebra of Propositions – Conditional and Bi conditional Statements (K2, K3)
1.4 Argument- Logical Implications- Propositional Functions (K3, K4)
1.5 Quantifiers- Negation of Quantified Statements (K4)
1.6 Normal Forms- Predicate Logic (K4)

Unit II **(14 Hours)**

2.1 Graph Theory: Introduction, Data Structures (K1)
2.2 Graphs and Multi graphs- Sub graphs, Isomorphic and Homeomorphic Graphs- Paths, Connectivity (K2)
2.3 The Bridges of Konigsberg, Traversable Multigraphs(K3)
2.4 Labeled and Weighted Graphs (K4)
2.5 Complete, Regular and Bipartite Graphs (K4, K5)
2.6 Tree Graphs- Planar Graphs-Graph Coloring (K4, K5)

Unit III **(11 Hours)**

1.1 Deterministic finite automata (DFA) (K3, K4)
1.2 Nondeterministic finite automata (NFA) (K3, K4)
1.3 Equivalence of DFA and NFA, and regular expressions (K3)
1.4 Regular expression and regular languages (K3, K4)
1.5 Non-regular languages and pumping Lemma (K4)
1.6 Closure properties (K4)

Unit IV **(12 Hours)**

4.1 Grammar Introduction– Types of Grammar (K1)
4.2 Context Free Grammars and Languages– Derivations and Languages (K1, K2)
4.3 Ambiguity- Relationship between derivation and derivation trees (K1, K3)
4.4 Simplification of CFG (K2)
4.5 Elimination of Useless symbols (K5)
4.6 Unit productions – Null productions (K5)

Unit V **(10 Hours)**

5.1 Pushdown automata and grammar simplification (K3)
5.2 Chomsky normal form (K4)
5.3 Pumping lemma for context-free languages (K4)
5.4 Turing Machines: Formal definition and behavior (K3)
5.5 Languages of a TM, TM as accepters (K4)
5.6 Types of TMs (K4)

Text Books:

1. Seymour Lipschutz, Marc Las Lipson, Varsha H Patil (2010). Discrete Mathematics, Fourth Edition, Tata McGraw Hill.
2. Hopcroft and Ullman (2002). Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, Delhi.

Reference Books:

1. Kenneth H.Rosen (2002). Discrete Mathematics and Its Applications, Fourth Edition, Tata McGraw Hill.
2. A.Tamilarasi&A.M.Natarajan (2005). Discrete Mathematics and its Application, Second Edition, Khanna Publishers.
3. K. L. P Mishra, N. Chandrashekaran (2003). Theory of Computer Science - Automata Languages and Computation, Second Edition, Prentice Hall of India, India.

Open Educational Resources (OER):

1. https://www.youtube.com/watch?v=LFKZLXVO-Dg
2. https://www.youtube.com/watch?v=58N2N7zJGrQ&list=PLBlnK6fEyqRgp46K4ZY69yXmpwKOIev

PECSD20 - ELECTIVE II B: SOFT COMPUTING

Year: I Sem: II	Course Code: PECSD20	Title of the Course: Elective II B: Soft Computing	Course Type: Theory	Course Category: Elective	H/W 5	Credits 4	Marks 100

Course Objectives

1. To Learn and Understand basics of Neural Networks.
2. Introduce and use the idea of neural networks and fuzzy logic.
3. To Learn Basics of Classification and Regression Algorithms.
4. Introduce and use the concepts of Genetic algorithm and its applications to soft computing.
5. Familiarize with soft computing concepts.

Course Outcomes (COs)

1. Describe Soft Computing Techniques and their roles in building Intelligent Machines
2. Analyze various fuzzy models in developing fuzzy inference system to be appropriate with specific real time problems.
3. Apply Specific Unsupervised and Supervised Neural Network to find the approximate solutions to real world Problems.
4. Use genetic algorithm to combinatorial Optimization Problems.
5. Present the feasibility of applying a Soft Computing methodology for specific problem.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	M	L	M	M	L	M
CO2	H	M	M	L	H	M
CO3	M	M	L	M	L	M
CO4	L	M	M	L	H	H
CO5	M	M	L	M	L	M

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I **(13 Hours)**

1.1 Artificial Neural Networks: Introduction-History of Artificial Neural Network(K1)
1.2 Knowledge Based Information processing: Neural Information Processing-Hybrid Intelligence (K1)
1.3 Basic Neural Computational Model:Basic Concepts of Neural Networks – Network Properties - Node Properties System Dynamics (K1)
1.4 Single Layer Perceptron: Multilayer Perceptron - Adalines- Competitive LearningHebbian learning (K1)
1.5 Supervised and Unsupervised: Explanation Based Learning- BACON learning -meta dendral(K1)
1.6 Neural Network Learning:Backpropagation- Applications (K2, K5)

Unit II **(14Hours)**

2.1 Fuzzy System: Set Theoretic Operations MF formulation and Parametrization Compositional Rule of Interface (K1)
2.2 Fuzzy sets and Fuzzy reasoning: Single rule with Single Antecedent – Single rule with Multiple Antecedent – Multiple rules with Multiple Antecedent(K1)
2.3 Decision making under Fuzzy States and FuzzyActions(K2, K3)
2.4 Fuzzy function –FuzzyDecomposition(K2, K3)
2.5 Fuzzy control methods:Mamdani fuzzy models -Sugeno fuzzy models - Tsukamoto fuzzy model (K4)
2.6 Fuzzy decision making: Input space Partitioning - Grid Partitioning - Application (K4, K5)

Unit III **(11 Hours)**

3.1 Neuro Fuzzy modeling:AdaptativeNeuro fuzzy Inference systems - Introduction -ANFIS Architecture – Hybrid Learning Algorithm (K3)
3.2 ANIFS As a Universal Approximation: Classification and Regression trees - Introduction Decision trees (K3)
3.3 CART Algorithm for Tree Introduction: Tree Growing - Classification Trees(K3)
3.4 RegressionTrees: Tree Growing - Tree Pruning (K3)
3.5 Rule Based Structure Identification: Introduction Input Selection (K3)
3.6 Rule Based Organization: Neuro fuzzy control I -Neuro fuzzy control I(K3)

Unit IV **(12 Hours)**

1.1 Introduction: Genetic Algorithm - Encoding Binary Encoding - Real Number Bumbing - Integer or literal Permutation encoding (K3)
1.2 Crossover: Single point crossover - Multi point Crossover - Uniform Crossover(K2)
1.3 Mutation – Single point Mutation - Multipoint Mutation (K3)
1.4 Selection – Roulette Wheel Selection - Rank Selection - Tournament Selection - Steady State selection (K4)
1.5 Generic Algorithm Parameters - Population size - Crossover rate - Mutation rate (K5)
1.6 Applications of Generic Algorithm - Advantages and Disadvantages of Genetic Algorithm (K5)

Unit V **(10 Hours)**

5.1 Introduction to Neuro fuzzy and Soft computing - Soft computing Constituents and conventional AI (K1, K3)
5.2 Conventional AI to computational Intelligence Neuro Fuzzy and Soft computing Characteristics (K2)
5.3 Search Strategies for AI Production systems Backtracking Strategies - GraphSearch Strategies (K2)
5.4 Heuristic Graph Search Procedures -Algorithm A -The Admissibility of A* - Comparison of AR Algorithms (K3, K4)
5.5 Predicate calculator in AI -Frames - Frames as sets and Instances - Semantic Nets (K4, K5)
5.6 Hybrid Model Applications - Fuzzy implement using Matlab (K4, K5)

Text Books:

1. S.N.Deepa and S.N.Sivanandham-Principles of Soft computing, Third Edition- Wiley India Pvt.Ltd., 2018.
2. N.P Padhy and S.P Simon-Soft computing with mat lab programming, oxford university press, 2015.
3. Jang J.S.R, Sun C.T and Mizutami E-Neuro Fuzzy and Soft Computing-Prentice Hail India, New Delhi, 2015.
4. LaureneFauseett-Fundamentals of Neural Networks-Prentice Hall India, New Delhi, 2008.

Reference Books:

1. S Rajasekeran, G.A Vijayalakshmipai, Neural Networks, Fuzzy logic and Genetic Algorithm, Synthesis and Application, PHI learning Pvt.Ltd., 2017.
2. Timothy J.Ross-Fuzzy Logic Engineering Application-Tata McGraw Hill, 1997.

Open Educational Resources (OER):

1. Introduction to Artificial Intelligence- Video Tutorial - https://youtu.be/J7LqgglEfQw
2. Fuzzy logics and fuzzy system - Video Tutorial- https://youtu.be/UIqrfHjXBjM

PCCSN20 – PRINCIPALS OF COMPILER DESIGN

Year: II **Sem:** III	**Course Code:** PCCSN20	**Title of the Course:** Principals of Compiler Design	**Course Type:** Theory	**Course Category:** Core	**H/W** 5	**Credits** 4	**Marks** 100

Course Objectives

1. Understand the basic concepts of compiler.
2. Discuss the functionality of Lexical analysis.
3. Illustrate the concepts of syntax analysis through parser and its types.
4. Define and List the intermediate codes.
5. Summarize the working features of Code Generation.

Course Outcomes (COs)

1. Explain the concepts of compiler and discuss the Code Generation
2. Describe the functionality of Lexical analysis.
3. Describe the functionality of Syntax analysis.
4. Define the storage organization and List the intermediate codes.
5. Summarize the working features of Code Generation.
6. Apply their basic knowledge of Data Structure to design Symbol Table, Lexical Analyzer, Intermediate Code Generation, and Parser.

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	L	L	M	H	M	L

CO2	M	L	M	H	M	M
CO3	M	M	L	M	L	M
CO4	H	L	M	M	L	H
CO5	L	M	M	L	H	M

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I **(13 Hours)**

1.1 Introduction: The Structure of a Compiler (K2, K4)
1.2 Lexical Analysis – BootStrap(K4)
1.3 Syntax Analysis- Semantic Analysis-Intermediate Code Generation (K4)
1.4 Code Optimization -Code Generation (K4, K5)
1.5 Symbol Table Management - The Grouping of Phases into Passes (K4, K5)
1.6 Compiler Construction Tools - The Evolution of Programming Languages (K3, K5)

Unit II **(14 Hours)**

1.1 Lexical Analysis: The Role of the Lexical Analyzer (K2, K4)
1.2 Input Buffering -Specification of Tokens (K4)
1.3 Recognition of Tokens (K2)
1.4 Finite Automata- Nondeterministic Finite Automata (K2)
1.5 Conversion of an NFA to a DFA (K5)

Unit III **(11 Hours)**

1.1 Construction of an NFA from a Regular Expression (K6)
1.2 Syntax Analysis: Introduction (K2)
1.3 Context-Free Grammars (K3)
1.4 Top-Down Parsing (K6)
1.5 Bottom-Up Parsing (K6)

Unit IV **(12 Hours)**

4.1 Introduction to LR Parsing (K2)
4.2 Intermediate Code Generation: Variants of Syntax Trees (K2, K4)
4.3 Three-Address Code (K2, K4)
4.4 Types and Declarations (K3)
4.5 Translation of Expressions. (K4, K5)

Unit V **(10 Hours)**

1.1 Code Generation: Design of a Code Generator (K2, K4)
1.2 Basic Blocks and Flow Graphs- Optimization of Basic Blocks (K2, K5)
1.3 Peephole Optimization- the Principal Sources of Optimization (K4, K2)
1.4 Introduction to data flow Analysis (K2)
1.5 Apply their basic knowledge of Data Structure to design Symbol Table, Lexical Analyzer, Intermediate Code Generation, Parser (Top Down and Bottom Up Design) (K3)

Text Books:

1. Alfred V Aho- Monica S. Lam- Ravi Sethi- Jeffrey D Ullman (2007). Compilers- Principles - Techniques and Tools. Addison-Wesley. Second Edition.

Reference Books:

1. Charles N. Fischer, Richard. J. LeBlanc (2008). Crafting a Compiler with C.
2. Randy Allen, Ken Kennedy (2002). Optimizing Compilers for Modern Architectures: A
3. Dependence- based Approach. Morgan Kaufmann Publishers.
4. Steven S. Muchnick (2003). Advanced Compiler Design and Implementation. Morgan
5. Kaufmann Publishers Elsevier Science. Indian Reprint.
6. Keith D Cooper and Linda Torczon (2004). Engineering a Compiler. Morgan Kaufmann
7. Publishers Elsevier Science.

Open Educational Resources (OER):

1. https://www.tutorialspoint.com/compiler_design/index.htm
2. https://en.wikipedia.org/wiki/Principles_of_Compiler_Design
3. https://www.youtube.com/watch?v=WccZQSERfCM&list=PLEbnTDJUr_IcPtUXFy2b1sGRPsLFMghhS&index=2

SEMESTER III

PECSE20 - ELECTIVE III A: INTERNET OF THINGS

Year: II **Sem:** III	**Course Code:** PECSE20	**Title of the Course:** Elective III A: Internet of Things	**Course Type:** Theory	**Course Category:** Elective	**H/W** 5	**Credits** 4	**Marks** 100

Course Objectives

1. To understand smart objects and IoT Architectures.
2. To learn various protocols at the different layers for IoT.
3. To develop prototype systems using Arduino.
4. To learn the design and development process involved in creating a cloud based application.
5. To apply the concept of Internet of Things in the real world scenario.

Course Outcomes (COs)

1. Understand the fundamentals of IoT.
2. Analyze different connectivity technologies for IoT.
3. Design a portable IoT using Arduino / equivalent boards and relevant protocols.
4. Deploy an IoT application and connect to the Fog.
5. Develop IoT applications with different platform and frameworks.

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	M	L	M	H	L	M
CO2	L	M	H	M	H	L
CO3	M	L	L	L	L	M
CO4	M	L	L	M	L	M
CO5	L	H	M	M	L	M

(Low - L, Medium – M, High – H)

Course Syllabus

Unit I **(17 Hours)**

1.1 Introduction to Internet of Things: Introduction - Characteristics of IoT(K1)
1.2 Applications of IoT - IoT Categories - Sensors (K1, K2)
1.3 Actuators - IoT Components and Implementation (K1, K3)
1.4 Challenges of IoT - IoT Networking: Connectivity Terminologies (K2)
1.5 Gateway Prefix Allotment (K3, K4)
1.6 IoT Identification and Data Protocols (K4, K6)

Unit II **(14 Hours)**

2.1 Connectivity Technologies: IEEE802.15.4 - ZigBee(K2, K3)
2.2 RFID - HART and Wireless HART - NFC - Bluetooth (K4, K6)
2.3 Z-Wave - Wireless Sensor Networks: Components of Sensor Nodes (K3)
2.4 Challenges in WSN - Applications of WSN - Wireless Multimedia Sensor Network (K2)
2.5 Wireless Nano sensor Networks - Under Water Acoustic Sensor Networks (K2, K4)
2.6 UAV Networks and M2M Communication: UAV Components - UAV Networks -M2M Communication (K2, K6)

Unit III **(15 Hours)**

1.1 Programming with Arduino: Features of Arduino - Program Elements (K2)
1.2 Cloud Computing: Characteristics - Deployment Models - Service Models (K1, K2)
1.3 Service Management - Cloud Security (K2, K3)
1.4 Sensor Cloud: Comparison with WSN - Sensor Cloud Architecture (K4, K6)
1.5 Advantages of Sensor Cloud - Sensor Cloud Services Life Cycle Model (K3)
1.6 Sensor Cloud Applications - Issues and Challenges in Sensor Cloud (K1, K3)

Unit IV **(16 Hours)**

4.1 Fog Computing: Requirements of IoT - Architecture of Fog (K1, K2)
4.2 Working - Advantages - Applications - Challenges in Fog (K2, K3)
4.3 Smart Homes: Smart Home Implementations - House Area Networks (K3, K6)
4.4 Smart Home benefits and Issues (K4)
4.5 Smart Grids: Characteristics of Smart Grid (K2, K3)
4.6 Components of Smart Grid - Smart Grid and Cloud(K1, K5)

Unit V **(12 Hours)**

5.1 Smart Cities: Characteristics of Smart Cities (K1, K2)
5.2 Smart City Framework (K2, K6)
5.3 Challenges in Smart City - Data Fusion - Smart Parking (K3, K6)
5.4 Industrial IoT: IIoT Requirements (K3, K4)
5.5 Applications of IIoT(K1, K4)
5.6 Benefits and Challenges of IIoT(K2, K3)

Text Books:

1. Dr.Jeeva Jose (2018), "Internet of Things", Khanna Book Publishing Co. (P) Ltd.

Reference Books:

1. Jan Holler, VlasiosTsiatsis (2014)," From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence" Academic Press, First Edition.
2. Vijay Madisett, ArshdeepBahga (2014), “Internet of Things - Hands-on Approach”, First Edition, VPT.

Open Educational Resources (OER):

1. https://www.ibm.com/blogs/internet-of-things/what-is-the-iot/
2. https://www.youtube.com/watch?v=UrwbeOIlc68

PICSB20 – GREEN COMPUTING

Year: I Sem: I	Course Code: PICSB20	Title of the Course: Green Computing	Course Type: Theory	Course Category: Independent Elective	H/W -	Credits 2	Marks 100

Course Objectives

1. Understand the dimensions and goals of Green IT.
2. Discuss the green enterprise architecture with environmental intelligence.
3. Analyze the Grid framework with the collaboration of cloud computing.
4. Understand the concept of Green compliance.
5. Apply Green IT strategies and applications of home appliances.

Course Outcomes (COs)

1. Understand the Concept of Green IT.
2. Discuss Green IT in relation to technology.
3. Evaluate IT use in relation to environmental perspectives.
4. Discuss the methods and tools to measure energy consumption.
5. Conclude with a Green IT to sustainable development and develop energy saving.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	L	L	M	M	L	H
CO2	M	L	M	L	H	M
CO3	L	M	L	M	L	M
CO4	M	M	L	H	M	L
CO5	M	H	M	L	M	L

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I

1.1 Green IT: An Overview: Introduction - Environmental Concerns and Sustainable Development - Environmental Impacts of IT (K1)

1.2 Green IT: OCED Green IT Framework – Green IT 1.0 and 2.(K1)

1.3 Holistic Approach to Greening IT:Greening Computer's Entire life Cycle – The Three Rs of Green IT (K1)

1.4 Greening IT: Green PCs, Notebooks and Servers – Green Data Centres – Green Cloud Computing – Green Data Storage – Green Software – Green Networking and Communication (K1, K2)

1.5 Applying IT for Enhancing Environmental Sustainability-Green IT Standards and Eco Labelling of IT - Enterprise Green IT Strategy(K1, K2)

1.6 Green Devices and Hardware: Introduction-Life Cycle of a Device or Hardware- Reuse, Recycle and Dispose (K1)

Unit II

2.1 Sustainable Software Development: Introduction - Current Practices - Sustainable Software- Software Sustainability Attributes (K1)

2.2 Software Sustainability Metrics: Modifiability and Reusability – Portability – Supportability – Performance – Dependability – Usability – Accessibility – Predictability – Efficiency – Project's Carbon Footprint (K1, K2)

2.3 Sustainable Software Methodology: Collecting Metrics – Code metrics Tools – Simplified Usability Study – Platform Analysis – Existing Project Statistics - Defining Actions (K2, K3)

2.4 Green Data Centres: Data Centres and Associated Energy Challenges(K1)

2.5 Data Centre IT Infrastructure: Servers – Networking – Storage – IT Platform Innovation -

Data Centre Facility Infrastructure-Implications for Energy Efficiency: Power System – Cooling – Facilities Infrastructure Management (K1, K3)

2.6 IT Infrastructure Management: Server Power – Consolidation – Virtualization (K2)

Unit III

3.1 Green Cloud Computing and Environmental Sustainability: Introduction -What is Cloud Computing? - Cloud Computing and Energy Usage Model (K1)

3.2 Features of Clouds Enabling Green Computing (K2)

3.3 Towards Energy Efficiency of Cloud Computing (K3)

3.4 Green Cloud Architecture (K2, K3)

3.5 Enterprise Green IT Strategy: Introduction-Approaching Green IT Strategies- Business Drivers of Green IT Strategy (K1, K3)

3.6 Business Dimensions for Green IT Transformation - Organizational Considerations in a Green IT Strategy (K3, K4,K6)

Unit IV

4.1 Sustainable Information Systems and Green Metrics: Introduction- Multilevel Sustainable Information (K2)

4.2 Sustainability Hierarchy Models: Sustainability Frameworks – Sustainability Principles – Tools for Sustainability (K4, K5, K6)

4.3 Product Level Information: Life-Cycle Assessment – The four stages of LCA – CRT Monitors versus LCD Monitors: Life Cycle Assessment (K3, K4)

4.4 Individual Level Information (K3)

4.5 Functional Level Information: Data Centre Energy Efficiency – Data centre Power Metrics – Emerging Data Centre Metrics (K4, K6)

4.6 Organizational Level Information: Reporting Greenhouse Gas Emissions (K4, K5)

Unit V

5.1 Green Enterprises and the Role of IT: Introduction-Organizational and Enterprise Greening: The Green Enterprise: A value chain Perspective(K2, K3)

5.2 Information Systems in Greening Enterprises: Environmental Management Information systems – Software and Databases – ERP EMISs – ERP Challenges and Deficiencies with Respect to EMIS – Integrating Environmental and LCA Information with ERP – Electronic Environmental and Sustainability Reporting (K3, K4, K5, K6)

5.3 Greening the Enterprise-IT Usage and Hardware: Environmental Information Technology Standards – Green Management of Data Centre (K2, K3)

5.4 Inter-organizational Enterprise Activities and Green Issues: Electronic Commerce and Greening the Extended Enterprise – Demanufacturing and Reverse Logistics- Eco-Industrial Parks and Information Systems - Enablers and Making the Case for IT and the Green Enterprise (K4, K5,K6)

5.5 Managing Green IT: Introduction-Strategizing Green Initiatives: Strategic Thinking – Strategic Planning – Strategic Implementation – Enterprise Architecture Planning(K2, K4)

5.6 Implementation of Green IT: Return on Investment – Metrics – The Goal-Question-Metric (GQM) - Information Assurance: Risk Management -Communication and Social Media(K5, K6)

Text Books:

1. San Murugesan, G.R. Gangadharan-Harnessing Green It Principles and Practices, A John Wiley & Sons, Ltd., Publication 2012.

Reference Books:

1. John Lamb, "The Greening of IT", Pearson Education, 2009.
2. Jason Harris, "Green Computing and Green IT– Best Practices on Regulations &Industry", Lulu.com, 2008.
3. Woody Leonhard, Katherrine Murray, "Green Home Computing for Dummies", August 2009.
4. Swarup K. Das, "Cloud Computing", Dominant Publishers, 2015.
2. PrasantaPattnaik, ManasKabat," Fundamentals of Cloud Computing", S.Chand (G/L) & Company Ltd; First edition (2014).

Open Educational Resources (OER):

1. https://www.google.com/url?sa=t&source=web&rct=j&url=http://www.vandemataramcollege.com/app/webroot/files/NOTES_sem246/Green_IT-FYCS-Sem2.pdf&ved=2ahUKEwjYgJaM_IXrAhUBX30KHeNtAFcQFjAAegQIARAB&usg=AOvVaw0gQehqD562q0zVa7ulBEH3&cshid=1596721284883
2. https://youtu.be/QYThOy_QiTU
3. https://www.youtube.com/watch?v=CRdm3xEJ97E
4. https://youtu.be/Nc8sNUcE-yk
5. https://youtu.be/6dSZyDRgl1M
6. https://youtu.be/X43KVeWVk

PICSC20 – DISTRIBUTED OPERATING SYSTEM

Year: I Sem: I	Course Code: PICSC20	Title of the Course: Distributed Operating System	Course Type: Theory	Course Category: Independent Elective	H/W -	Credits 2	Marks 100

Course Objectives

1. To expose students to both the abstraction and details of file systems.
2. To introduce concepts related to distributed computing systems.
3. To focus on performance and flexibility issues related to systems design decision.
4. To expose students to current literature in distributed systems.
5. To prepare students for an industrial programming environment.

Course Outcomes (COs)

1. Understand the architecture of distributed operating system.
2. Differentiate between centralized and distributed system.
3. Determine the difficulties of distributed memory management.
4. Analyze effective synchronization techniques to be performed to run a task in a distributed system.
5. Evaluate the best methods to follow to execute a task in remote machines.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	M	L	M	L	M	L
CO2	L	L	M	L	H	M
CO3	M	M	L	M	H	L
CO4	M	H	L	M	L	H
CO5	H	M	M	L	L	M

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I

1.1 Introduction to Distributed System (K1)
1.2 Communication in Distributed System: Remote Procedure Call(K2)
1.3 Synchronization in distributed system (K4)
1.4 Clock Synchronization (K2)
1.5 Mutual Exclusion (K2)
1.6 Deadlocks in Distributed System (K4)

Unit II

1.1 Process and Processors in Distributed System: Threads (K3, K4)
1.2 System Models (K2)
1.3 Processor allocation (K2)
1.4 Scheduling in Distributed Systems (K4)
1.5 Fault Tolerance (K5)
1.6 Real Time Distributed System (K4)

Unit III

3.1 Distributed Object Based Systems: Architecture (K2, K4)
3.2 Processes-Object Servers: Communication (K2, K4)
3.3 Distributed Objects: Binding a client to an object – Static Versus Dynamic – Remote Method Invocations (K2)
3.4 Parameter Passing – Naming: CORBA Object References – Globe Object Reference - Synchronization – Consistency and Replication (K2)
3.5 Distributed File Systems: Distributed File System Design – Distributed File System Implementation – File Usage (K2, K4)
3.6 System Structure – Caching – Replication –Trends in Distributed File System (K2, K4)

Unit IV

4.1 Distributed Shared Memory: Introduction – Shared Memory (K1, K2)
4.2 Consistency Models – Page based (K2, K3)
4.3 Distributed Shared Memory (K1, K2)
4.4 Shared Memory (K2)
4.5 Shared Variable Distributed Shared Memory (K2)
4.6 Object Based Distributed Shared Memory (K2)

Unit V

5.1 Distributed Web Based Systems: Architecture – Processes (K2)
5.2 Communication – Naming –Synchronization (K1, K2)
5.3 Consistency and Replication (K2)
5.4 54 Case Study: AMOEBA – Introduction –Objects and Capabilities (K2)
5.5 Process Management (K1, K2)
5.6 Memory Management – Communication (K1, K2)

Text Books:

1. Andrew S.Tanenbaum (2011). Distributed Operating System, 10/e, Pearson Education.

Reference Books:

1. ShubhraGarg (2013).Fundamentals of Distributed Operating Systems, S.K. Kataria& Sons.
2. YakupPaker et al (2012). Distributed Operating Systems: Theory and Practice, Springer.
3. S SKudate, A P Kale et al (2012). Distributed Operating Systems, NiraliPrakashan.

Open Educational Resources (OER):

1. http://indexof.es/Varios2/Modern%20Operating%20Systems%204th%20Edition.pdf
2. http://stst.elia.pub.ro/news/SO/Modern%20Operating%20System%20-%20Tanenbaum.pdf
3. https://www.amazon.com/Operating-Systems-Design-Implementation-3rd/dp
4. https://www.youtube.com/watch?v=Azyizl9w2xo&list=PLrjkTql3jnm9FEOXHA_qjR-TMODlaIk-W&index=1
5. https://www.youtube.com/watch?v=wmMEbrGq_nU
6. https://www.youtube.com/watch?v=ipm5hDz9zG0
7. https://www.youtube.com/watch?v=oKlEjKDUkAs

PICSE20 - DIGITAL IMAGE PROCESSING

Year: I **Sem:** II	**Course Code:** PICSE20	**Title of the Course:** Digital Image Processing	**Course Type:** Theory	**Course Category:** Independent Elective	**H/W** -	**Credits** 2	**Marks** 100

Course Objectives

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques.
3. To understand the fundamentals of Color Image Processing.
4. To study image restoration procedures.
5. To study Region based Segmentation procedures.

Course Outcomes (COs)

1. Understand the basics of Graphics
2. Understand the fundamentals and applications of digital image processing and be aware about intensity transformations.
3. Explore knowledge about image processing fundamentals.
4. Know about various noise models and transformation techniques.
5. Able to know the structure of XML and to design and store data in XML

CO	**PSO**					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	M	L	M	L	M	H
CO2	M	L	L	M	L	M
CO3	H	M	L	M	H	M
CO4	M	H	L	M	L	M
CO5	L	L	M	M	L	M

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I

1.1 Introduction to Computer Graphics - Video Display Devices (K1, K2)

1.2 Raster Scan Systems -Random Scan Systems - Interactive Input Devices (K1)

1.3 Hard Copy Devices - Graphics Software - Output Primitives (K1, K3)

1.4 Line Drawing Algorithms: DDA Algorithm- Initializing Lines - Line Function.(K1, K4)

1.5 Two dimensional geometric transformations – Matrix representations and homogeneous coordinates (K1)

1.6 Three dimensional concepts; Three-dimensional object representations – Polygon surfaces (K1, K3)

Unit II

2.1 Digital Image Processing – Introduction – The Origins of Digital Image Processing (K1, K2)

2.2 Classification of Digital Images – Image Types - Examples of Fields That Use Digital Image Processing (K1)

2.3 Fundamental Steps In Digital Image Processing – Components of An Image Processing System (K1, K2)

2.4 Intensity Transformation and Spatial Filtering (K3)

2.5 Background – Some Basic Intensity Transformation Functions (K3)

2.6 Different types of Transformation functions (K1, K4)

Unit III

3.1 Histogram Processing – Fundamentals of Special Filtering (K1, K2)

3.2 Smoothing Spatial Filters – Sharpening Spatial Filters (K2, K3)

3.3 Color Image Processing – Color Fundamentals – Color Models (K3)

3.4 Implementing Web Services (K4)

3.5 To Pseudo color Image Processing – Basics of Full-Color Image Processing – Color Transformation. (K4, K5)

3.6 Smoothening and Sharpening (K4)

Unit IV

1.1 Image Restoration and Reconstruction – A model of the Image Degradation/Restoration process (K5)

1.2 Noise Models – Spatial and Frequency properties of Noise – Some important Noise Probability Density Functions (K2)

1.3 Periodic Noise – Estimation of Noise Parameters – Restoration in the Presence of Noise only (K1, K3)

1.4 Spatial Filtering – Mean Filters – Order Statistic Filters (K3)

1.5 Adaptive Filters – Estimating the Degradation Function (K4)

1.6 Estimation by Image Observation – Estimation by Experimentation – Estimation by Modelling. (K3, K5)

Unit V

5.1 Region Based Segmentation – Region Growing (K5)

5.2 Region Splitting and Merging (K1, K2)

5.3 Segmentation Using Morphological Watersheds. (K1)

5.4 Background – Dam Construction (K1, K2)

5.5 Watershed Segmentation Algorithm. (K1, K3)

5.6 The use of motion in segmentation (K5)

Text Books:

1. Rafael C. Gonzalez & Richard E. Woods (2018). Digital Image Processing. FourthEdition. Pearson Edition.

Reference Books:

1. Yogesh M. Rajput (Ramesh R. Manza Dnyaneshwari D. Patil (2017). Projects in Digital Image Processing. Spd Edition.
2. Jayaraman (2012). Digital Image Processing. Tata McGraw-Hill Education.
3. Burger WilhemEt (2010). Al Principles of Digital Image Processing: Fundamental Techniques springerutics publication.

Open Educational Resources (OER):

1. https://www.tutorialspoint.com/dip/index.htm
2. https://www.javatpoint.com/digital-image-processing-tutorial
3. https://www.geeksforgeeks.org/digital-image-processing-basics/

PICSI20 – EMBEDDED SYSTEM

Year: II Sem: III	Course Code: PICSI20	Title of the Course: Embedded System	Course Type: Theory	Course Category: Independent Elective	H/W -	Credits 2	Marks 100

Course Outcomes (COs)

1. Understand the Concepts of Embedded Systems.
2. Recognize the concepts of Network devices.
3. Gain the knowledge of Device Drivers and Interrupts Servicing Mechanism.
4. Acquire the knowledge of Real Time Operating Systems.
5. Understand Program Modeling Concepts.

CO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	L	M	M	L
CO2	M	L	M	H	M	M
CO3	L	M	M	M	L	H
CO4	M	M	L	M	L	M
CO5	H	M	L	L	M	L

CO	PO					
	1	2	3	4	5	6
CO1	H	L	L	M	L	M
CO2	M	H	L	H	M	L
CO3	H	L	M	H	L	M
CO4	H	M	L	L	M	L
CO5	L	M	L	H	M	L

(Low - L, Medium – M, High - H)

Course Syllabus

Unit I

1.1 Introduction to Embedded Systems: Embedded Systems (K2, K4)
1.2 Processor Embedded into a System – Embedded Hardware and Software (K4)
1.3 SOC and use of VLSI Circuit design Technology (K3, K4)
1.4 Complex System Design and Processor (K4)
1.5 Design Process in Embedded System and Design Examples (K4, K5)
1.6 Classification of Embedded Systems (K4)

Unit II

2.1 Devices and Communication Buses for Devices Networks: IO types (K2)
2.2 Serial Communication Devices – Parallel Devices Port (K2, K4)
2.3 Interfacing Features in Device Ports – Wireless Devices (K2, K5)
2.4 Timer and Counting Devices – Watchdog Timer (K2, K4)
2.5 Real Time Clock - Networked Embedded Systems (K4, K6)
2.6 Serial Bus Communication Protocols (K2, K4)

Unit III

3.1 Device Drivers and Interrupts Servicing Mechanism: Programmed-I/O (K2, K4)
3.2 Busy-wait Approach without Interrupt Service Mechanism – ISR (K2, K4)
3.3 Interrupt Sources - Interrupts Servicing Mechanism (K2, K5)
3.4 Multiple Interrupts (K4)
3.5 Context and the Periods for Context Switching, Interrupt Latency and Deadline (K2, K4)
3.6 Classification of Processors Interrupt Servicing Mechanism from Context Saving Angle (K4)

Unit IV

4.1 Real Time Operating Systems: OS Services (K2)
4.2 Process Management – Timer and Event Functions (K2, K4)
4.3 Memory Management – Device, file and IO Subsystems Management (K2, K4)
4.4 Interrupt Routines in RTOS Environment and Handling of Interrupts Source Calls (K4, K5)
4.5 RTOS - Basic Design using RTOS (K2, K4)
4.6 RTOS Task Designing Models (K2, K4)

Unit V

5.1 Program Modeling Concepts: Program and DFG Models (K2, K4)
5.2 Finite State Model (K2)
5.3 State Machine Programming Models (K2, K5)

5.4 Modeling of Multiprocessor Systems (K4)

5.5 ADL Modeling (K4)

5.6 Embedded Software Development Process and Tools: Introduction Embedded Software Development Process and Tools (K2, K4)

Text Books:

1. Raj Kamal (2014). Embedded Systems Architecture, Programming and Design. Tata McGraw Hill Publishing Company Limited. Second Edition.

Reference Books:

1. Julio Sanchez Maria P. Canton (2017).Embedded Systems Circuits and Programming's press.
2. Jack Ganssle (2012). The Art of Designing Embedded Systems. Elsevier. Second Edition.
2. David E. Simon (2010). An Embedded Software Primer. Pearson Education.

Open Educational Resources (OER):

1. https://en.wikipedia.org/wiki/Embedded_system
2. https://www.tutorialspoint.com/embedded_systems/es_overview.htm
3. https://www.guru99.com/embedded-systems-tutorial.html
4. https://www.youtube.com/watch?v=nccWuB5ypxI&list=PLcbIZiT62e1gNZ-VWPO3rpTpXkHBMZa2n
5. https://www.youtube.com/watch?v=RcP6cYJb0ZE