Subject Code: PECS-103

Subject Name: Agile Software Development

Programme: B.Tech. (CSE)	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE)**: 3 hrs
Total Marks: 100	**Course Status**: Elective

Prerequisites: Knowledge of software engineering fundamentals.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

PART-A

Introduction: Need of Agile software development, agile context– Manifesto, Principles, Methods, Values, Roles, Artifacts, Stakeholders, and challenges. Business benefits of software agility. **[7 Hours]**

Project Planning: Recognizing the structure of an agile team– Programmers, Managers, Customers. User stories– Definition, Characteristics and content. Estimation– Planning poker, Prioritizing, and selecting user stories with the customer, projecting team velocity for releases and iterations. **[7 Hours]**

Project Design: Fundamentals, Design principles–Single responsibility, Open-closed, Liskov substitution, Dependency-inversion, Interface-segregation. **[8 Hours]**

PART-B

Design Methodologies: Need of scrum, Scrum practices –Working of scrum, Project velocity, Burn down chart, Sprint backlog, Sprint planning and retrospective, Daily scrum, Scrum roles– Product Owner, Scrum Master, Scrum Team. Extreme Programming- Core principles, values and practices. Kanban, Feature-driven development, Lean software development. **[9 Hours]**

Testing: The Agile lifecycle and its impact on testing, Test driven development– Acceptance tests and verifying stories, writing a user acceptance test, Developing effective test suites, Continuous integration, Code refactoring. Risk based testing, Regression tests, Test automation. **[9 Hours]**

Text Books

1. Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", International Edition, Pearson.
2. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", First International Edition, Prentice Hall.
3. Pedro M. Santos, Marco Consolaro, and Alessandro Di Gioia, "Agile Technical Practices Distilled: A learning journey in technical practices and principles of software design", First edition, Packt Publisher.

Reference Books

1. Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", International edition, Addison Wesley.
2. Alistair Cockburn, "Agile Software Development: The Cooperative Game", 2nd Edition, Addison-Wesley

E-Books and Online learning material

1. "The Complete Guide to Agile Software Development" https://clearbridgemobile.com/complete-guide-agile-software-development/
2. "Agile Fundamentals Ebook: A Complete Guide for Beginners", https://agileken.com/agile-fundamentals-ebook/

Online Courses and Video lectures

1. "Agile Software Development", https://www.edx.org/course/agile-software-development Accessed on August 27, 2021.
2. "Agile Software Development", https://www.coursera.org/learn/agile-software-development Accessed on August 27, 2021.

Subject Code: PECS-104

Subject Name: Object Oriented Analysis and Design Using UML

Programme: B.Tech. (CSE)	**L: 3 T: 0 P: 0**
Semester: 7	**Teaching Hours**: 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE)**: 3 hrs
Total Marks: 100	**Course Status**: Elective

Prerequisites: Knowledge of software engineering fundamentals.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction: Introduction to Object Oriented Development, Introduction to Object Oriented analysis and design with fundamentals, Various Principles of modeling, Need of Object-Oriented analysis and design**. [5 Hours]**

System and Process: Introduction to SDLC, Iterative and evolutionary analysis and design, Agile modeling, Class Modeling, State Modeling and Interaction Modeling. **[4 Hours]**

Various UML Diagrams and Relationships: Use case diagram, Class diagram, Object diagrams, Aggregation, Generalization, Association and multiplicity, Activity diagram, State diagram, Sequence diagram, Collaboration diagram, Component diagram. **[5 Hours]**

Structural Modeling: Classes, Access specification, Advanced classes, Interface types, Introduction to Packages, Introduction to Instances and object, Need of SRS document, creation of Software Requirement Specification Documentation. **[6 Hours]**

Part-B

Behavioral Modeling: Interactions and examples, Introduction to Use cases and Use case diagrams. Conditional messaging & Branching in Interaction diagrams. **[5 Hours]**

Architectural Modeling: Nodes and connections in Component diagrams, Modeling a client/server system, Deployment diagrams components, Reverse Engineering, Difficulties and risks in use-case modeling.**[5 Hours]**

OO Methodologies: OO Methodologies (Structured Analysis, Structured Design (SA/SD), Reverse Engineering, Difficulties and risks in use-case modeling and UI design, System testing and maintenance**. [3 Hours]**

Case Studies: Case studies for Railway reservation, Library management system, Online mobile recharge, Familiarization of open source tools for UML Design such as Plant UML, Argo UML etc. **[3 Hours]**

Text Books

1. Frederick Eddy, James Rumbaugh, Michael Blaha, Willliam Premerlani, William Lorensen, "Object-Oriented Modeling and Design", 1st Edition, Pearson Education.
2. James Rumbaugh, Michael R. Blaha, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education.
3. Timothy C. Lethbridge, Robert Laganiere, "Object Oriented Software Engineering, Practical Software Development using UML and Java", 2nd Edition, Tata McGraw-Hill
4. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, "UML 2 Toolkit", 3rd Edition, WILEY-Dreamtech India Pvt. Ltd.

Reference Books

1. Meilir Page-Jones, "Fundamentals of Object Oriented Design in UML", 2nd Edition, Pearson Education.
2. Pascal Roques, "Modeling Software Systems Using UML2", 3rd Edition, WILEY-Dreamtech India Pvt. Ltd.
3. Atul Kahate, "Object Oriented Analysis & Design", 2nd Edition, The McGraw-Hill Companies.
4. Mark Priestley, "Practical Object-Oriented Design with UML", 2nd Edition, TATA McGrawHill.

E-Books and online learning material

1. HandBook: https://www.cs.drexel.edu/~spiros/teaching/CS575/slides/uml.pdf
2. HandBook: http://www.cs.kent.edu/~jmaletic/cs63901/lectures/UML.pdf

Online Courses and Video lectures

1."Object Oriented Analysis and Design", https://nptel.ac.in/courses/106/105/106105153/ Accessed on August 20, 2021.
2."Object Oriented System Development using UML, Java and Patterns", https://nptel.ac.in/courses/106/105/106105224/# Accessed on August 20, 2021.

Subject Code: PECS-105

Subject Name: Software Metrics

Programme: B.Tech CSE	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Knowledge of software engineering fundamentals.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Software Metrics: Measurement in software engineering, software metrics, Metrics data collection and analysis. **[3 Hours]**

Complexity Metrics and Models: Lines of Code, Halstead's Software Science, Cyclomatic Complexity Syntactic Metrics, and An Example of Module Design Metrics in Practice. Object Oriented Projects: Object Oriented Concepts and Constructs, Productivity Metrics, Quality Management Metrics.

[7 Hours]

Estimate internal product attributes: Aspects of software size, length, functionality, and complexity, measuring structure, types of structural measures, control-flow structure, and modularity and

information flow attributes, data structures. **[6 Hours]**

Estimate external product attributes: Modeling software quality, software reliability, software reliability problem, parametric reliability growth models, predictive accuracy, importance of operational environment, and wider aspects of software reliability**.** **[3 Hours]**

Part-B

Component-based system: Metrics for object-oriented systems, Object-oriented analysis and design and its characteristics. **[3 Hours]**

MOOD metrics: Component-based metrics and its characteristics and various component-based suites. **[3 Hours]**

Dynamic Metrics: Runtime Software Metrics, Extent of Class Usage, Dynamic Coupling, Dynamic Cohesion, and Data Structure Metrics. [**5 Hours]**

Software Quality: Concepts of software quality, software quality control and software quality assurance, evolution of SQA, major SQA activities and issues, zero defect software. Software Quality Assurance: SQA techniques; Management review process, technical review process, walkthrough, software inspection process, configuration audits, and document verification. **[7 Hours]**

Text Books

1. Norman E-Fentor and Share Lawrence Pflieger, "Software Metrics: A Rigorous and Practical Approach", 2nd Edition, International Thomson Computer Press.
2. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson.

Reference Books

1. Gerald M. Weinberg, "Quality Software Management Volume 1: Systems Thinking", Dorset House Publishing.
2. Capers Jones, "Applied Software Measurement", 3rd Edition, Tata McGraw Hill.

E-Books and online learning material

1. "Software metrics for the curious developer", https://www.codacy.com/ebooks/guide-to-code-quality
2. "Software Metrics", https://people.ucalgary.ca/~far/Lectures/SENG421/PDF/SENG421-01.pdf

Online Courses and video lectures

1. "Software Engineering", https://nptel.ac.in/courses/106/101/106101061/
   Accessed on August 24, 2021

Subject Code: PECS-107

Subject Name: Component Based Development

Programme: B.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Knowledge of software engineering fundamentals.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Component Definition: Definition of Software Component and its Elements. Component Models and Component Services: Concepts and Principles, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High-Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization. **[9 Hours]**

Software Engineering Practices: The Practice of Software Engineering, From Subroutines to Subsystems: Component-Based Software Development. The Design of Software Component Infrastructures: Software Components and the UML, Placing Software Components in Context, Business Components, Components and Connectors: Catalysis Techniques for Defining Component Infrastructures, An Open Process for Component-Based Development, Designing Models of Modularity, and Integration. **[9 Hours]**

Part-B

The Management of Component-Based Software Systems: Measurement and Metrics for Software Components, The Practical Reuse of Software Components, Selecting the Right COTS Software: Why

Requirements are Important, Software Component Project Management Processes, The Trouble with Testing Software Components, configuration Management and Component Libraries, The Evolution, Maintenance and Management of Component-Based Systems. **[9 Hours]**

Component Technologies: Overview of the CORBA Component Model, Transactional COM+: Designing Scalable Applications, The Enterprise JavaBeans Component Model, Choosing Between COM+, EJB, and CCM, Software Agents as Next Generation Software Components. **[9 Hours]**

Text Books

1. Katharine Whitehead, "Component-Based Development: Principles and Planning for Business Systems", 1st Edition, Addison-Wesley.
2. Don Box, "Essential COM", 1st Edition, Addison-Wesley.

Reference Books

1. George T. Heineman, William T. Councill", "Component-Based Software Engineering: Putting the Pieces Together", 1st Edition, Addison-Wesley Professional.
2. G Sudha Sadasioam, "Computer-based Technology", 1st Edition, Wiley India.

E-Books and online learning material

1. "Component-based software engineering", https://core.ac.uk/download/pdf/232274627.pdf

Online Courses and Video Lectures

1."Component based model in Software Engineering", https://www.youtube.com/watch?v=3ApdgLdYrDU Accessed on July 29, 2021

2. "Component Based Development", **https://www.youtube.com/watch?v=o6f1TG83fWI** Accessed on July 29, 2021

Subject Code: LPECS- 102

Subject Name: Object Oriented Analysis and Design Using UML Laboratory

Programme: B.Tech.(CSE)	**L:** 0 **T:** 0 P**:** 2
Semester: 7	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):**2 hrs
Total Marks: 50	**Course Status:** Elective

Prerequisites: Knowledge of software engineering fundamentals.

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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 modelling techniques.

List of Practicals

1. Study of OpenProj or similar software related to measure the UML.
2. Usage of OpenProj or similar software to draft the diagrams for object oriented analysis and design.
3. Getting familiar with the importance of UML compilers and its benefits.
4. Design and draft the Class Modeling for Railway reservation etc.
5. Design and draft the State Modeling for Library management system etc.
6. Design and draft the Interaction Modeling for Online mobile recharge etc.
7. Getting familiar and hands on practice with tools like Plant UML, Argo UML etc

Reference Material

Manuals available in Lab.

Subject Code: LPECS-103

Subject Name: Component Based Development Laboratory

Programme: B.Tech. CSE	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 01
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Knowledge of software engineering fundamentals.

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

List of Practicals

1. Preparation of software configuration management and risk management related documents.
2. Design software component infrastructure with the help of suitable tools.
3. Study different COTS software and find out which one is cost effective.
4. To identify and narrate Test cases, Test scripts/procedures and Test incident report identifier for the system under test.
5. Study Orbacus and install orbacus for C++ Server.
6. Execute various basic CORBA commands for declaring CORBA IDL Module, interface and operations.
7. Study and use different enterprise JAVA Beans Component Model.
8. Create a mini project by using any tool of Component Based Development.

Reference Material

Manuals available in Lab

Subject Code: PECS-109

Subject Name: Software Defined Networks

Programme: B.Tech. (CSE)	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Data Communication and Networks

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction: Historical Background of Software Defined Networking (SDN), The SDN Approach: Requirements, Characteristics of Software-Defined Networking, The Modern Data Center, Traditional Switch Architecture: Data Control and Management Planes, Centralized and Distributed Control and Data Planes. **[6 Hours]**

Software Defined Networking (SDN): The need of SDN, Fundamental Characteristics of SDN, SDN Operation, SDN Devices: Flow Tables, SDN software switches, hardware SDN devices, SDN Applications. **[6 Hours]**

Network Functions Virtualization: Background and motivation for NFV- Virtual Machines- NFV Concepts: Simple example of use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements-NFV Reference Architecture. **[5 Hours]**

SDN Controllers: SDN Controllers: Core modules, Its Interfaces, implementations, Alternative SDN Methods: SDN via APIs, SDN via Hypervisor Based Overlays. **[4 Hours]**

Part- B

The Open Flow Specification: Overview: Open Flow Switch, Open Flow Controller, Open Flow Protocol, the controller-switch Secure channel, Open Flow basics: Ports and Port Queues, Flow Table, Packet Matching, Actions and Packet Forwarding, Messaging Between Controller and Switch and its examples, Open Flow Limitations. **[6 Hours]**

SDN Data and Control plane: SDN data plane: Data plane Functions, Data plane protocols, SDN Control Plane: SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers. SDN Application Plane: SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN **[7 Hours]**

SDN in the Data Center: Data Center Definition, Data center demands, Tunneling Technologies for Data center, Path technologies in the data center, Ethernet Fabrics in the data Center, SDN use Cases in Data Center: Overcoming Current Network Limitations, Adding, Moving, and Changing Resources, Failure Recovery, Traffic Engineering and Path Efficiency. **[6 Hours]**

Text Books

1. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Illustrated Edition, Morgan Kauffman.

2. Thomas D.Nadeau and Ken Gray, "SDN-Software Defined Networks", Illustrated Edition, O'Reilly Publishers.

3. William Stallings, "Foundations of Modern Networking", Pearson.

Reference Books

1. Jim Doherty, "SDN and NFV Simplified", 1st Edition, Addison Wesley.

2. Siamak Azodoimolky, "Software Defined Networking with OpenFlow", Packet Publishing Limited.

3. Fei Hu, Editor, "Network Innovation through Open Flow and SDN: Principles and Design", 1st Edition, CRC Press.

E-Books and online learning material

1. Feamster, Nick, Jennifer Rexford, and Ellen Zegura, "The road to SDN: an intellectual history of programmable networks", ACM SIGCOMM Computer Communication

Review 44.2 (2014): 87-98.

2. Kreutz, Diego, et al, “Software-defined networking: A comprehensive survey”, Proceedings of the IEEE 103.1 (2015): 14-76

3. Nunes, Bruno AA, et al., “A survey of software-defined networking: Past, present, and future of programmable networks”, Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.

Online Courses and Video Lectures

1. “Software Defined Networking”, https://www.coursera.org/learn/sdn

Accessed on September 10, 2021.

2. “Software Defined Networking - I (Basics)”, https://www.youtube.com/watch?v=CaukSKg_sI0

Accessed on September 10, 2021.

3.“Software Defined Networking - II (Open Flow)”, https://www.youtube.com/watch?v=l3E-C1j-SJg

Accessed on September 10, 2021.

Subject Code: PECS-110

Subject Name: Wireless Sensor Networks

Programme: B.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 7	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Computer Networks

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction to wireless communication: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels: Path loss, fading, interference, Doppler effect, Transmission rate constraints. Modulation Techniques, Multiple Access Techniques, wireless LANs, PANs, WANs, and MANs. **[6 Hours]**

Wireless Sensor Networks: History of Wireless Sensor Networks, Introduction to Wireless sensor networks, Key definitions, Unique constraints and challenges, Differentiate between traditional networks and wireless sensor networks, advantages of ad-hoc/sensor network, Design issues and challenges in wireless sensor networks **[6 Hours]**

Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Architecture of a wireless sensor Network, Node architecture, Protocol stack, Communication in wireless sensor network: flooding, gossiping. data dissemination and Data Aggregation **[6 Hours]**

Part- B

MAC Protocols in WSN: Overview, design issues in MAC protocols, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, classification of MAC protocols, Contention-Free MAC Protocols, Contention-Based MAC Protocols with Reservation, Contention-Based MAC Protocols with Scheduling Mechanisms and Hybrid MAC Protocols **[7 Hours]**

Routing Protocols: Overview, Routing metrics, Issues in designing a routing protocol, Flooding and Gossiping classification of routing protocols, Data-Centric Routing, Proactive Routing/ table-driven, On-Demand Routing, Hierarchical Routing, Location-Based Routing and QoS-Based Routing Protocols. **[7 Hours]**

Applications and Future Trends: Applications and case studies on Structural Health Monitoring, Habitat Monitoring, Health Monitoring, Traffic Control, Precision Agriculture, Tracking Chemical Plumes. Future Research Directions: Security and privacy in sensor networks, Embedded Systems Networks of High-Data-Rate Sensors Light weight Signal Processing **[4 Hours]**

Text Books

1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks", 2nd Edition, Pearson Education.
2. Feng Zhao and LeonidesvGuibas, "Wireless sensor networks ", 1st Edition, Elsevier publication.

Reference Books

1. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson Education.
2. William Stallings, "Wireless Communications and Networks ", 2nd Edition, Pearson Education.

E-Books and online learning material

1. Wireless Sensor Networks by Kazem Sohraby, Daniel Minoli and TaiebZnati http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02

2. An Introduction to Wireless Sensor Networks by Carlo Fischione https://www.kth.se/social/files/5431a388f276540a05ad2514/ An_Introduction_WSNS_V1.8.pdf

Online Courses and Video Lectures

1. "Ad-hoc and Sensor Networks", https://nptel.ac.in/courses/106105160/ Accessed on July 24, 2021.
2. "Wireless Ad Hoc and Sensor Networks", https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/ Accessed on July 24, 2021

Subject Code: PECS-113

Subject Name: Blockchain Technology

Programme: B.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems: NIL**
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Computer Networks

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction to Cryptography: Need of Cryptography, Traditional and Modern techniques, Hash function, Distributed Hash Table, Digital Signatures, Symmetric and Asymmetric Key Cryptography, Zero Knowledge Proof, Double Spending problem. **[6 Hours]**

Introduction to Blockchain: Distributed Database, shortcomings of current transaction systems, distributed network, difference between blockchain and traditional database, evolution of blockchain. Bitcoin's Architecture, Blockchain Architecture: merkle root tree, gas limit, transactions and fee, nonce value, anonymity, reward, chain policy, miners, validators, types (private and public blockchains), Challenges to Blockchain Implementation, Features of Blockchain Network, Soft & Hard Fork. **[8 Hours]**

Distributed Consensus I: The mining mechanism, Two Generals Problem, Byzantine General problem and Fault Tolerance, Nakamoto consensus, Evaluation aspects Blockchain consensus protocols: Scalability, Throughput (TPS), Latency, Security, Fault Tolerance Rate, Energy

Consumption. **[5 Hours]**

Part-B

Distributed Consensus II: Consensus Algorithms: Proof of Work, Proof of Stake, Delegated Proof of Stake, Proof of Activity, Comparison among them. **[5 Hours]**

Ethereum: Public consortium blockchain: Introduction of Ethereum, Ethereum account, Ethereum network, Ethereum client, Ethereum gas, Ethereum virtual machine, Ethereum block, header, Ether, smart contracts. **[6 Hours]**

Blockchain use cases: Applications in finance: settlements, KYC, capital markets, insurance; supply chain: provenance of goods, visibility, trade supply chain finance, invoice management discounting; government: digital identity, land registration; medical information systems. **[6 Hours]**

Textbooks

1. Sam Gounder, 'Blockchain Technologies, Applications And Cryptocurrencies: Current Practice And Future Trends', World Scientific.
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform.
3. Arvind N., Joseph B., Edward F., Andrew M., and Steven G., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press.

Reference Books

1. Henning Dendrich, 'Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations', CreateSpace Independent Publishing Platform.
2. Melanie Swan, 'Blockchain: Blueprint for a New Economy', O'Reilly Media, Inc., 1st edition.
3. Neeraj Kumar, N. Gayathri, Md. Arafatur Rahram and B. Balaguram, 'Blockchain, Big Data and Machine Learning: Trends and Applications', CRC Press, Taylor and Francis.

E-books and online learning material

1. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, White Paper.
2. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper.
3. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts.

Online lectures

1. "Introduction to Blockchain Technology and Applications", https://nptel.ac.in/courses/106/104/106104220/ Accessed on September 16, 2021
2. "Blockchain Architecture Design and use Cases", https://nptel.ac.in/courses/106/105/106105184/ Accessed on September 16, 2021

Subject Code: PECS-112

Subject Name: Internet of Things

Programme: B.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 15% Cloud
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Computer Networks

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction to Internet of Things (IoT): IoT Definition, IoT Vision, Smart and Hyper-connected Devices, Conceptual Framework, Architectural View, Technology behind IoT, Major Components of IoT System, Sources of IoT, Examples of IoT. **[6 Hours]**

IoT & M2M: Difference between IoT and Machine to Machine, M2M Architecture, SNMP protocol, IoT reference model, Lightweight M2M Communication Protocol, Domain model - information model, functional model, communication model. **[6 Hours]**

Design Principles for Web Connectivity: Constrained Application Protocol, JSON (Java Script Object Notation) Format, Tag Length Value Format, MIME (Multipurpose Internet Mail Extension)

Type, Message Communication Protocols for Connected Devices, Web Connectivity for Connected Devices Network. **[6 Hours]**

Part-B

IoT Reference Architecture: Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment, Constraints affecting design of IoT, Technical design Constraints. **[6 Hours]**

Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Environmental and Agriculture applications, Other IoT applications. **[6 Hours]**

Developing IoT solutions: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi Implementation of IoT with Arduino and Raspberry, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT. **[6 Hours]**

Text Books

1. Davis Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry, "IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things", 5th Impression, CISCO Press.
2. Mayur Ramgir, "Internet of Things – Architecture, Implementation and Security", 1st Impression, Pearson India.
3. Raj Kamal, "Internet of Things – Architecture and Design Principles", 5th Reprint Edition, McGraw - Hill Education.
4. Arsheep Bahga, Vijay Madisetti, "Internet of Things – A Hands-On Approach", 3rd Impression, Universities Press.
5. Gaston C. Hillar, "Internet of Things with Python", 2nd Impression, PACKT Open Source Press.

Reference Books

1. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet of Things with Raspberry Pi and Arduino", 1st Impression, CRC Press.
2. Ashwin Pajankar, "Internet of Things with Arduino and Bolt", 2nd Impression, BPB Publications.

E-Books and online learning material

1. Donald Noris, "The Internet of Things", Mc Graw Hill Education, New York https://www.pdfdrive.com/download.pdf?id=176037121&h=c064c3b7014c0ed46f60e480e4a5b625&u=cache&ext=pdf.

2. Aleksandr Kapitonov, Raivo Sell “Introduction to Internet of Things”, Erasmus Education, Ritankar Sahu Publisher
http://iot-open.eu/download/io1-introduction-to-the-iot/?wpdmdl=2702&_wpdmkey=6022469db61f3&refresh=6022469dbfe3a1612859037.

Online Courses and Video Lectures

1. “Introduction to Internet of Things**”,**https://www.digimat.in/nptel/courses/video/106105166/L01.html.
Accessed on September 4, 2021.
2. “Computer Networks and Internet Protocol”, https://onlinecourses.nptel.ac.in/noc21_cs18/preview.
Accessed on September 4, 2021.

Subject Code: LPECS-105

Subject Name: Wireless Sensor Networks laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Computer Networks

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks.
CO2	Be familiar with the features, merits and demerits of Wireless Sensor Network Tools.
CO3	Apply the knowledge to configure various network topologies.
CO4	Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.
CO5	Apply the knowledge to identify appropriate performance parameter of Routing protocols.
CO6	Understand the key features of Ad hoc and sensor networks

List of Practicals

1. Study of Wireless sensor network simulation tools and its comparison with merits and demerits.
2. Installation and configuration of any simulation tool MATLAB/NS2/ OPNET++ /etc.
3. Implementation of basic network topology using any simulation Tool and analysis.
4. Implementation of cluster and hierarchical topologies using any simulation Tool.
5. Implementation of LEACH protocol using any simulation Tool.
6. Implementation of DSR routing protocol using any simulation Tool.
7. Implementation of AODV routing protocol using any simulation Tool.
8. Study other wireless sensor network simulators (Mannasim,Contiki)
9. Analyze the performance comparison of implemented protocols (any two).

Reference Material

Manuals available in Lab.

Subject Code: LPECS-106

Subject Name: Internet of Things laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Computer Networks

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

List of Practicals

1. Familiarization with Arduino/ Raspberry Pi and perform necessary software installation.
2. Demonstrate the communication modules like BLE, WIFI, XBEE.
3. Interfacing Arduino to Zigbee module.
4. Communicate between Arduino and Raspberry PI using any wireless medium.
5. Interface LED/ Buzzer with Arduino/ Raspberry Pi and write a program to turn ON/OFF LED for specific duration.
6. Interface DHT11/ DHT22 sensor with Arduino/ Raspberry Pi and write a program to print temperature and humidity readings.
7. Interface PI Camera with Arduino/ Raspberry Pi and write a program to start the camera and to place the clicked pictures on the desktop
8. Interface PIR Sensor with Arduino/ Raspberry Pi and write a program to check the motion of PIR sensor.
9. Setup a cloud platform to log the data.
10. Log Data using Raspberry PI and upload to the any cloud platform.

Mini Project: Students are required to prepare a mini project based on IoT system as per course contents.

Reference Material

Manuals available in Lab.

Subject Code: PECS-115

Subject Name: Data Warehousing and Data Mining

Programme: B.Tech. (CSE)	L: 3 T: 1 P: 0
Semester: 7	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Fundamentals of database systems

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
CO1	Analyse 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 analyse 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.

Detailed Contents:

Part-A

Introduction to Data Warehousing and Data Mining: Historical developments in data warehousing, Defining data warehousing, Data warehouse architecture, Benefits of data warehousing, Data Granularity, The Information Flow Mechanism, Metadata, Two Classes of Data, The Lifecycle of Data, Data Flow from Warehouse to Operational Systems, Data Warehouse v/s Data Mining, Data Mining Applications, Data Mining Process, Data Mining Techniques, Predictive modelling, Database segmentation, Link analysis, Deviation detection, Difference between Data Mining and Machine Learning. **[6 Hours]**

The Building Blocks of a Data Warehouse: Data Warehouse: The Need for an Operational Data Store

(ODS), Operational Data Store, Data Marts: Comparative Study of Data Warehouse with OLTP and ODS, Data Warehouse Schema, Introduction to Data Warehouse Schema: Dimension, Measure, Fact Table, Multi-dimensional view of data, Star Schema, Snowflake Schema, Fact Constellation Schema (Galaxy Schema) , Comparison among Star, Snowflake and Fact Constellation Schema. **[8 Hours]**

Online Analytical Processing: Introduction to Online Analytical Processing, Defining OLAP, OLAP applications, Features of OLAP, OLAP Benefits, Strengths of OLAP, Comparison between OLTP and OLAP, Differences between OLAP and data mining. **[5 Hours]**

Part-B

Data Mining Techniques: Introduction to Data Preprocessing, Data Preprocessing Methods, Introduction to Classification, Types of Classification, Input and Output Attributes, Working of Classification, Guidelines for Size and Quality of the Training Dataset, Decision Tree Classifier, Naïve Bayes Method. [**6 Hours]**

Cluster Analysis and Association Mining: Cluster Analysis, Applications of Cluster Analysis , Desired Features of Clustering , Distance Metrics: Euclidean distance, Manhattan distance, Chebyshev distance, Major Clustering Methods/Algorithms, Partitioning Clustering, Hierarchical Clustering Algorithms (HCA), Introduction to Association Rule Mining, Defining Association Rule Mining, Representations of Items for Association Mining, The Metrics to Evaluate the Strength of Association Rules, The Apriori Algorithm. **[7 Hours]**

Data mining tools, Applications and Case Studies: Introduction to WEKA, Application of Data Warehousing (Data Visualization) and Data Mining (Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining)

Study 1: OLAP for the Fast Food Industry

Study 2: Intrusion Detection using kNN classification **[8 Hours]**

Text Books

1. Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, 1st edition, Cambridge University Press.

2.Reema Thareja, "Data Warehousing", Edition, Oxford University Press.

3. Jiawei Han and Micheline Kamber, "Data Mining Concepts & Techniques", 3rd edition, Elsevier Pub.

4. Paulraj Ponniah, "Data Warehousing Fundamentals", 2nd Edition, John Wiley & Sons, Inc.

Reference Books

1. Margret H. Dunham "Data Mining: Introductory and Advanced topics", 4th Edition, Pearson

Education

2. Vikram Pudi, P. Radha Krishana “Data Mining”, 2009 Edition, Oxford University press.

E-Books and online learning material:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts & Techniques”, Elsevier Pub.

2. “Learn Data Warehousing in 1 Day: Complete ETL guide for beginners” by Krishna Rungta

Online Courses and Video Lectures:

1. “Data Warehousing Tutorial for Beginners”,

https://freevideolectures.com/course/3609/data-warehousing Accessed on August 6, 2021.

2. “Data Warehouse Examples”,

https://www.coursera.org/lecture/dwdesign/data-warehouse-examples-video-lecture-hU1gW

Accessed on August 6, 2021.

Subject Code: PECS-117

Subject Name: Cloud Computing

Programme: B.Tech (CSE)	**L:**3 **T:**0 **P:**0
Semester: 7	**Teaching Hours:** 36
Theory / Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Fundamentals of database systems

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcome (CO)
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 platforms.

Detailed Contents:

Part-A

Cloud Computing Fundamentals: Evolution of cloud computing, Overview of computing paradigms: Distributed computing, Parallel computing, Cluster computing, Grid computing, Utility computing, Edge Computing, Fog Computing, and Cloud computing. The NIST model of cloud computing, Benefits and challenges of cloud computing, Big Data, Internet of things (IoT). Introduction to Mobile cloud computing. **[8 Hours]**

Cloud Concepts and Technologies: Virtualization: Definition, Characteristics and benefits of virtualization, Virtualization and cloud computing, Types of virtualization, and Load balancing, Classic datacenter, Virtualized datacenter. Hypervisors, Types of hypervisors, Multitenancy, Scalability and elasticity, Service level agreement (SLA). **[8 Hours]**

Part-B

Cloud Architecture and Services: Cloud computing reference model architecture, Common Cloud Management Platform (CCMP), Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud-based services and applications: Cloud computing for healthcare, Energy systems, Transportation systems, Manufacturing industry, Government, and Education. Cloud deployment models: Public, Private, Community, and Hybrid cloud. **[8 Hours]**

Security in Clouds: Cloud security issues and challenges, Cloud security reference model, Encryption techniques: Symmetric key encryption and Asymmetric key encryption. Identity and key management, Digital signature, Secure Socket Layer (SSL). **[6 Hours]**

Cloud Computing Platforms: Study and comparison of various open source and commercial cloud platforms. **[6 Hours]**

Text Books

1. Raj Kumar Buyya, James Broberg, Andrezei Goscinski, "Cloud Computing: Principles and Paradigms", 1st Edition, John Wiley and Sons Inc.
2. Barrie Sosinsky, "Cloud Computing Bible", 1st Edition, Wiley India Pvt. Ltd.
3. John Rittinghouse, James F.Ransome, "Cloud Computing: Implementation, Management, and Security", International Edition, CRC Press Taylor and Francis Group.
4. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper," Cloud Computing for Dummies", International Edition, John Wiley and Sons Inc.

Reference Books

1 R.L. Krutz and R.D. Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India.

2 Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing Concepts, Technology, & Architecture" 1st Edition, Prentice Hall

3 Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGrawHill.

4 Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, "Mastering Cloud Computing", Tata McGrawHill.

E –Books and online learning Material

1. Introduction to Cloud Computing by Dan C. Marinec, https://www.cs.ucf.edu/~dcm/Tutorials/RCIS-Tutorial.pdf

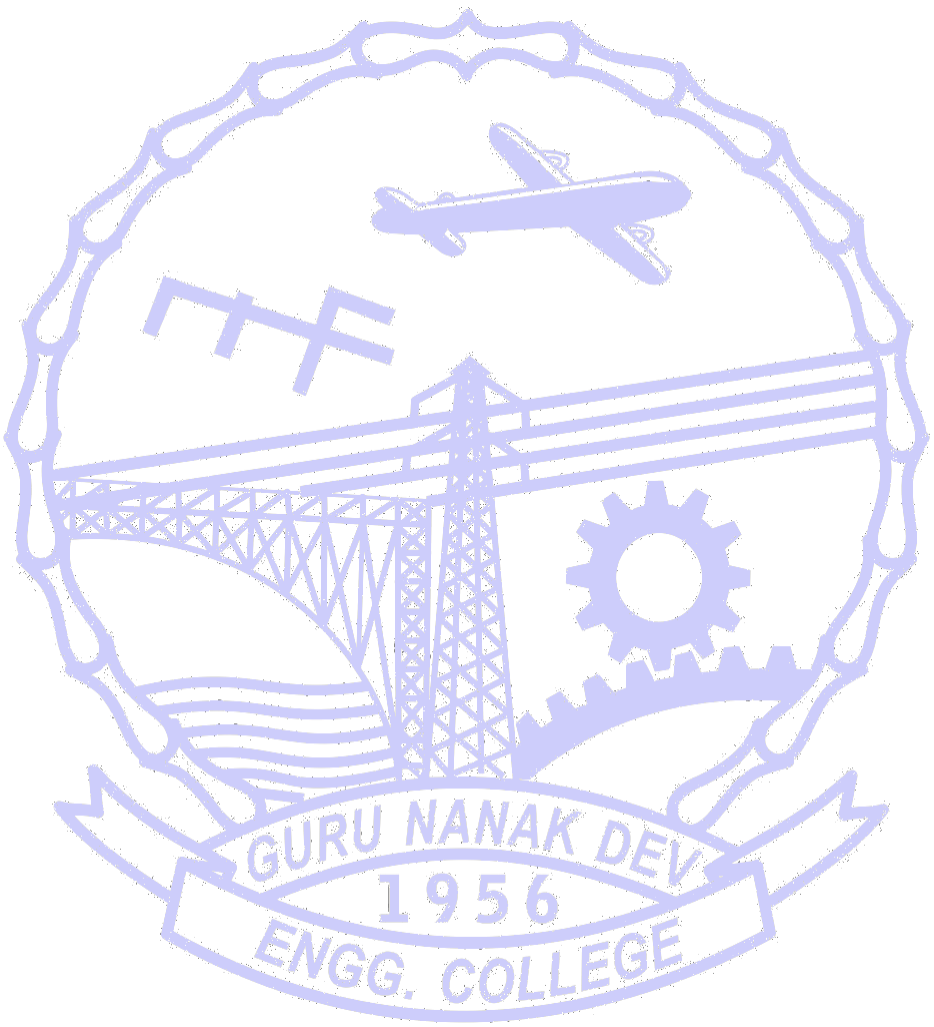
2. Security Guidance for Critical Areas of Focus in Cloud Computing by Cloud Security Alliance, https://cloudsecurityalliance.org/artifacts/security-guidance-v4/

Online Courses and Video Lectures

1 "Cloud Computing", https://youtu.be/NzZXz3fJf6o Accessed on September 11, 2021.

2 "Cloud Computing Architecture", https://youtu.be/fZ3D6HQrWzs Accessed on September 11, 2021.

3 "Cloud Computing Architecture-Deployment Models", https://youtu.be/4xrYN2Ecmas Accessed on September 11, 2021.



Subject Code: PECS-118

Subject Name: Big Data

Programme: B.Tech. (CSE)	L: 3 T: 0 P: 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Data Mining

Additional Material Allowed in ESE: NIL

On Completion of the course student should be able to:

CO#	COURSE OUTCOMES (CO)
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.

Detailed Contents

Part-A

Introduction to Big Data: Big data overview, V's of big data, Data structures, State of the practice in analytics, Current analytical architecture, Drivers of big data, Big data ecosystem and a New Approach to Analytics, Key roles for the new big data ecosystem, Data at rest v/s data at motion, Examples of big data analytics tools. **[5 Hours]**

Apache Hadoop: Understanding distributed system and Hadoop, Comparing SQL databases and Hadoop, MapReduce building blocks of Hadoop –Name node, Data node, Secondary name node, Job-Tracker, Task-Tracker, Introducing and configuring Hadoop cluster – Local, Pseudo distributed mode, Fully distributed mode, Handling web-based Cluster, and Configuring XML files. **[7 Hours]**

Working with Hadoop: Interacting with HDFS, Steps to read and write into HDFS. Anatomy of MapReduce Program – Hadoop data type, Mapper and Reducer, Partitioner, Combiner, Reading and

writing format, Word count with predefined Mapper and reducer. Introduction to with Hive and Spark. **[7 Hours]**

Part-B

Big Data Management: In-database Analytics – Introduction to NoSQL– Aggregate data models, Graph databases, Graph-less databases, Distribution models, Introduction to HBase, MongoDB, and Cassandra. **[7 Hours]**

Business Analytics: Decision making in business analytics, Business analytics in practice – Financial analytics, Healthcare analytics, Sport and web analytics. Categorization of analytics methods and models – Descriptive analytics, Predictive analytics, Perspective analytics. **[4 Hours]**

Analytical Methods and Case studies: Linear regression, Logistic regression, K-Means clustering, Decision tree classification. Case studies: Social data analytics, Recommendation engines, Customer analytics. **[5 Hours]**

Text Books

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", First Edition, Wiley.
3. Parag Kulkarni, Sarang Joshi,S.Brown, "Big Data Analytics", PHI Learning Pvt. Ltd.
4. Paul C. Zikopoulos, Chris Eaten, Dirk Deroos, "Understanding Big Data", McGraw Hill.

Reference Books

1. Chuck Lam, "Hadoop in Action", Reprint edition, Dreamtech Press
2. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC2, First Edition, Wiley Publications.
3. Jeffrey D. Camm, "Essentials of Business Analytics", First Edition, CENGAGE Learning.
4. Jared Dean, "Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners", First Edition, Wiley Publications.
5. Eric Siegel, Thomas H. Devanport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", First Edition, Wiley Publications.

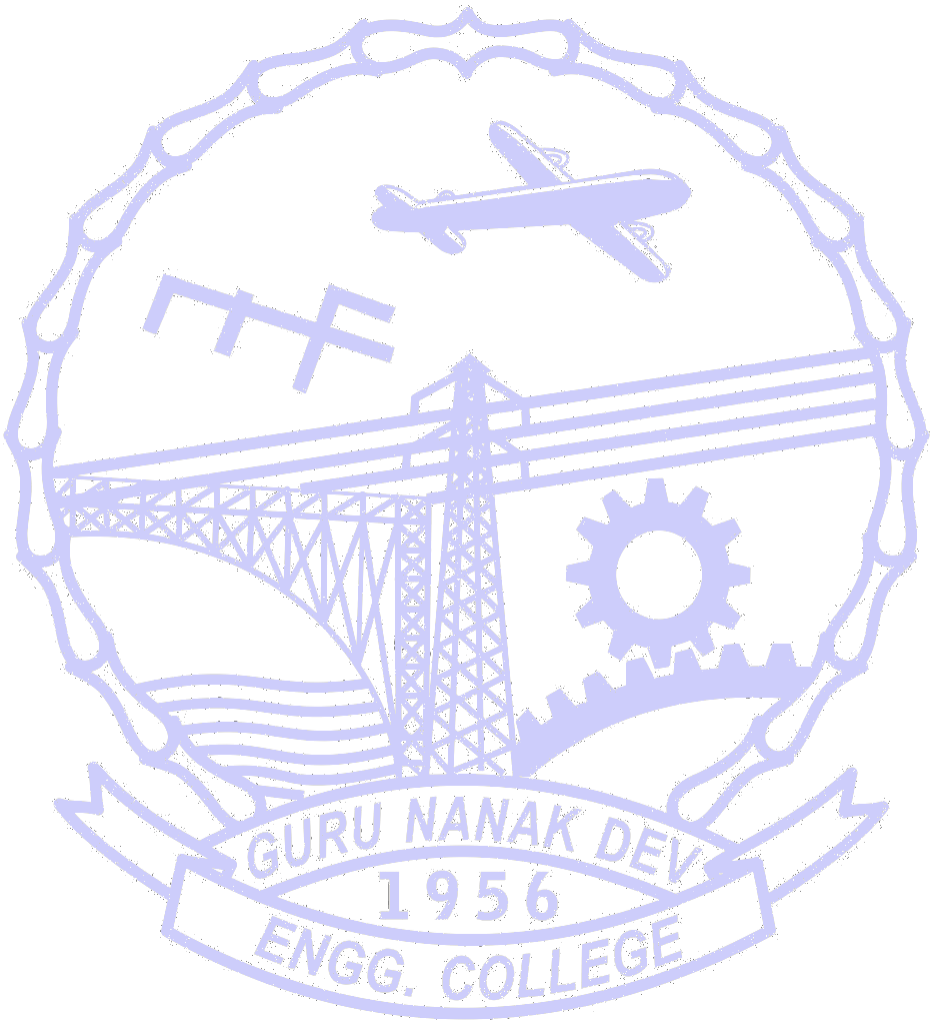
E-Books and Online Learning Material

1. Lecture Notes on Big Data and Business Analytics by Ms. G. Sulakshana and Ms. G. Srilekha https://www.iare.ac.in/sites/default/files/NEW%20LECHURE%20NOTES.pdf
2. Online Book "Big Data- Principles and Paradigms" by Rajkumar Buyya http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/Big%20Data%20Principles%20and%20Paradigms.pdf

Online Courses and Video Lectures

1. "Big Data Computing", https://nptel.ac.in/courses/106/104/106104189 Accessed on July 20, 2021

2. "Introduction to Data Analytics", https://nptel.ac.in/courses/110/106/110106072/ Accessed on July 20, 2021



Subject Code: PECS-119

Subject Name: Data Science

Programme: B.Tech. (CSE)	**L: 3 T: 0 P: 0**
Semester: 8	**Teaching Hours**: 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE)**: 3 hrs
Total Marks: 100	**Course Status**: Elective

Prerequisites: Knowledge of basic programming and mathematical functions.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

PART-A

Introduction: Introduction to Data Science, Introduction to Big Data, Relationship between Big Data and Data Science, Benefits and uses of Data science and Big data. Data Structure: Structured vs Unstructured Data. Drivers of big data, Data Growth-issues and challenges, Data Science vs Business Intelligence**.** **[6 Hours]**

Data Collection and Data Science Process: Sources of Data, Data collection and APIs, Data Science Process: Goal setting, retrieving data, data preparation, data cleansing and transformation, exploratory data analysis, data visualization, Model building and performance evaluation, presentation. **[6 Hours]**

Data Representation: Various Forms of data, Text data, Graph-based data. Modern databases- text files, spreadsheets, SQL databases, NoSQL databases, Distributed databases, Live data streams, Image, Sensor and Network data. Dataset Terminology: Observations and variables, Discrete and Continuous variables, Quantitative and Qualitative variables, Dependent and Independent variables. **[8 Hours]**

PART-B

Data Exploration: Introduction and purpose of EDA (Exploratory Data Analysis), Descriptive statistics: mean, median and mode, variance and measures of variance: standard deviation, range, skewness, correlation, correlation. Handling anomalous values, missing values and outliers. **[9 Hours]**

Data Visualization: Purpose and techniques of Data visualization: Histograms, Box Plots, Scatterplots. Normal Distribution: meaning and its characteristics, concept of transformations, transformation functions: Power function, Exponential function, Polynomial function, Model building and variable selection, Dimensionality, Feature selection methods: forward selection and backward selection procedure, stepwise selection procedure. Concepts of overfitting and under-fitting. Model validation and comparison: Confusion matrix: accuracy, precision and recall, ROC Curve. **[9 Hours]**

Text Books

1. Sinan Ozdemir and Sunil Kakade, "Principles of Data Science", Second Edition, Packt Publishing.
2. Roger D. Peng and Elizabeth Matsui: "The Art of Data Science", Lean Publishing
3. Joel Grus, Data Science from Scratch, Second Edition, O'Reilly

Reference Books

1. Foster Provost & Tom Fawcett: "Data Science for Business" O'Reilly
2. Roger D. Peng, R Programming for Data Science

E-Books and Online learning material

Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science - Big Data, Machine Learning and More Using Python Tools, Manning Publications Co.
http://bedford-computing.co.uk/learning/wp-content/uploads/2016/09/introducing-data-science-machine-learning-python.pdf

Online Courses and Video lectures

1. "Data Science for Engineers", https://nptel.ac.in/courses/106/106/106106179/ Accessed on September 10, 2021
2. "Python for Data Science", https://nptel.ac.in/courses/106/106/106106212/ Accessed on September 10, 2021
3. "Foundations of Data Science", https://www.youtube.com/watch?v=WEBUWYxaqLQ Accessed on September 10, 2021

Subject Code: LPECS-108

Subject Name: Cloud Computing Laboratory

Programme: B.Tech (CSE)	**L:**0 **T:**0 **P:**2
Semester: 7	**Teaching Hours:** 24
Theory / Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Fundamentals of database systems

On Completion of the course, the student will have the ability to:

CO#	**Course Outcome (CO)**
CO1	Make use of CloudSim toolkit for performing different experiments
CO2	Apply CloudAnalyst 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.

List of Practicals

I. Use CloudSim Toolkit and do the following:

1. To create a datacenter with one host and run one cloudlet on it.
2. To create two datacenters with one host each and two cloudlets on them.
3. To create two datacenters with one host each and run cloudlets of two users on them.
4. To create a datacenter with one host and a network topology and run one cloudlet on it.
5. To create two datacenters with one host each and run cloudlets of two users with network topology on them.

II. Use CloudAnalyst Simulation tool and do the following:

1. Set up a simulation with one datacenter and one userbase.
2. Set up a simulation with multiple datacenters and multiple userbases in various regions of the world.
3. Use closest data center service broker policy and throttled load balancing algorithm to set up a simulation.
4. Configure the simulation tool to analyse the performance of social networking App.

III. Examine the architecture and services offered by any one of the following cloud platforms.

1. Amazon Cloud platform
2. Google Cloud Platform
3. Microsoft Azure Cloud platform.

Reference Material

Manuals available in Lab.

Subject Code: LPECS-109

Subject Name: Data Science Laboratory

Semester: 8	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE)**: 2 hrs
Total Marks: 50	**Course Status**: Elective

Prerequisites: Fundamentals of database systems

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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

List of Practicals

1. Introduction to R.
2. Programs to implement use of Variables and Data types in R.
3. Program to implement Arithmetic, Logical and Matrix operations in R.
4. Program to implement concept of Functions.
5. Program to implement control structures.
6. Program to Read and Write data from dataset.
7. To study and write program for using Linear Algebra for Data Science.
8. To study various libraries and packages for Data Visualization in R.
9. Write a program to find data distribution using box and scatter plot.
10. Write a program to find outliers using plot.
11. Write a program to plot Histogram and Bar chart on sample data.

Minor project:

Students are required to develop a project to use various Data Science constructs like box, scatter plot, Histogram, Dimensionality, Transformation to visualize sample dataset.

Reference Material

Manuals available in Lab.

Subject Code: - PECS-121

Subject Name: Computer Vision

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks:40	**Percentage of Numerical Content:** 20%
External Marks:60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Course Status:** Elective

Prerequisites: Digital Image Processing

Additional Material Allowed in ESE:- NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
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.

Detailed Contents:

Part-A

Digital Image Formation and Low-Level Processing: Introduction to Computer Vision, Image Formation: Photometric Image Formation, Reflectance Capture and Representation, Image Sensing Pipelining, Sampling and Aliasing, Image Compression; Image Processing: Operations, Linear Filtering, Correlation, Convolution, Image in Frequency Domain, Image Sampling. **[9 Hours]**

Visual Features and Representations: Edge Detection, Image Gradients, Canny Edge Detection, More Recent Methods in Edge Detection, Blobs Detection, Corner Detection, Harris Corner Detector; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc. **[9 Hours]**

Part-B

Feature Detection and Matching: Human Visual System, Feature Matching. Hough transform; From points

to Images: Bag-of-words, VLAD Representations; RANSAC, Image Descriptor Matching, Pyramid Matching. **[8 Hours]**

Segmentation and Pattern Analysis: Region Splitting and Merging, Edge Based approaches to segmentation, Graph-Cut,K-Means and mixtures of Gaussians, Mean-Shift, MRFs, Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA [**8 Hours]**

Applications of Computer Vision: Motion Estimation and Object Tracking, Gesture Recognition, Face and Facial Expression Recognition, Image Fusion. [**6 Hours]**

Text Books

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 1st Edition, Springer.
2. Gonzaleze and Woods, "Digital Image Processing", 4th Edition, Pearson.
3. Richard Hartley, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press.

Reference Books:

1. KeinosukeFukunaga, "Introduction to Statistical Pattern Recognition", Academic Press Professional, Inc. San Diego, CA, USA.
2. Anil K. Jain, "Fundamental of Digital Image Processing", Prentice-Hall of India Pvt. Ltd

E-Books and online learning material

1. Computer Vision – Algorithms and Applications http://szeliski.org/Book/
2. Computer Vision Metrics https://link.springer.com/book/10.1007%2F978-1-4302-5930-5

Online Courses and Video Lectures

1. "Computer Vision", https://nptel.ac.in/courses/106/105/106105216/
Accessed on September 15, 2021
2. "Computer Vision", https://swayam.gov.in/nd1_noc19_cs58/preview
Accessed on September 15, 2021

Subject Code: PECS-122
Subject Name: Soft Computing

Programme: B.Tech.	**L**: 3 **T**: 0 **P**: 0
Semester: 7	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits**: 3
Internal marks: 40	**Percentage of numerical/design/programming problems**: 20%
External marks: 60	**Duration of end semester exam (ESE):** 3 hrs
Total marks: 100	**Course status:** Elective

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents:

Part-A

Introduction: Introduction to soft computing, Definition and importance, Evolution of soft computing, Difference between Hard and Soft computing, Requirement of Soft computing, Usefulness and applications. **[6 Hours]**

Neural Networks: Introduction to Neural Networks, Model of an artificial neuron, Comparison of artificial neural network and Biological neural network, Activation Functions, Recurrent Neural Networks, Neural network models– Perceptron, Adaline and medaline networks, Single layer, Back propagation, Multi-layer networks. **[11 Hours]**

Part- B

Fuzzy Logic: Crisp and fuzzy sets, Fuzzy sets – Membership functions, Basic operations, Properties and fuzzy relations, Predicate logic, Fuzzy Decision Making, Fuzzy rule based system, Fuzzy inference system, Applications of fuzzy logic. **[7 Hours]**

Genetic Algorithms: Working principle– Crossover, Mutation, Encoding, Fitness function and

Reproduction, Classification of genetic algorithm, Multi-objective genetic algorithm, Application of GA in search and optimization. **[7 Hours]**

Nature Inspired Algorithms: Cukcoo Search Algorithm, Fire Fly Algorithm, Fruit Fly Algorithm, Bat Algorithm, Particle Swarm Optimization, Bee Colony Optimization, Ant Colony Optimization. **[5 Hours]**

Text Books

1. V. Kecman, 'Learning and Soft Computing", MIT Press.
2. S. Rajasekaran and G.A.V. Pai, "Neural Networks, Fuzzy logic and Genetic Algorithms", Eastern Economy Edition, Prentice Hall of India.
3. D.E. Goldberg, "Genetic Algorithms in Search and Optimization, and Machine Learning", 13th Edition, Addison-Wesley.
4. Ross T.J., "Fuzzy Logic with Engineering Applications", 4th Edition, McGraw Hill.

Reference Books

1. S. N. Sivanandam and S. N.Deepa, "Principles of soft computing", 1st Edition, Wiley India.
2. Simon Haykin, "Neural Network- A Comprehensive Foundation", 2nd Edition, Prentice Hall International, Inc.
3. Bart Kosko, "Neural Network and Fuzzy Systems", 4th Edition, Prentice Hall, Inc

E-Books and online learning material:

1. https://www.youtube.com/watch?v=Z_8MpZeMdD4
2. https://bookboon.com/en/introduction-to-soft-computing-ebook
3. https://www.academia.edu/32241003/TB04_soft_computing_ebook

Online Courses and Video Lectures:

1. "Introduction to Soft Computing", https://nptel.ac.in/courses/106/105/106105173/ Accessed on September 17, 2021.
2. "Introduction to Soft Computing", https://onlinecourses.nptel.ac.in/noc20_cs17/preview Accessed on September 17, 2021.
4. "Neural Networks and Applications", https://nptel.ac.in/courses/117/105/117105084/ Accessed on September 17, 2021.

Subject Code: PECS-123
Subject Name: Human Computer Interaction

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Course Status:** Elective

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO #	Course Outcomes (CO)
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.

Detailed Contents:

PART-A

Foundations of Human Computer Interaction: Introduction to HCI, The Human: I/O channels, Memory, Reasoning and Problem Solving; The Computer: Devices, Memory, Processing and Networks; Interaction: Models, Frameworks, Ergonomics, Styles, Elements, Interactivity and Paradigms. **[8 Hours]**

Design Process and Implementation: Interactive Design Basics: Process, Scenarios, Navigation, Screen Design, Iteration and Prototyping. HCI in Software Process: Software Life Cycle, Usability Engineering, Prototyping in Practice, Design Rationale. Design Rules: Principles, Standards, Guidelines, Rules. Evaluation Techniques: Universal Design. **[8 Hours]**

User and Task Model: Cognitive Models, Socio-Organizational Issues and Stakeholder Requirements, Analyzing Tasks, Dialog Notations and Design. **[6 Hours]**

PART-B

Web Interface Design: Hypertext, Multimedia, World Wide Web, Overlays, Inlays and Virtual Pages, Contextual Tools, Designing Process, Case Studies. **[5 Hours]**

User Interface Evaluation: Heuristic Evaluation, Evaluation with Users, Model-based Evaluation, Mobile Application Frameworks, Types of Mobile Applications, Mobile Design Architecture and its Elements. **[5 Hours]**

Computing Theories & Recent Trends: Groupware and Computer Supported Collaborative Work, Ubiquitous Computing, Virtual Reality and Augmented Reality, Speech Recognition and Translation. **[4 Hours]**

Text Books

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education.
2. Ben Shneiderman, Maxine Cohen, Catherine Plaisant, Steven M. Jacobs, "Designing the User Interface", 5th Edition, Pearson Education.
3. K. Meena, R. Sivakumar, "Human-Computer Interaction" PHI Learning, Delhi.
4. Shneiderman, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition, Pearson Education India.

Reference Books

1. Brian Fling, "Mobile Design and Development", 1st Edition, O"Reilly Media Inc.
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", 1st Edition, O"Reilly.
3. Dr. Samit Bhattacharya, "Human-Computer Interaction: User-Centric Computing for Design", 1st Edition, McGraw-Hill.

E-Books and online learning material

1. Human Computer Interaction https://www.researchgate.net/publication/224927543_HumanComputer_Interaction/link/02e7e51a84759ab04d000000/download
2. HCI - Fundamentals and Practice http://www.ittoday.info/Excerpts/HCI.pdf
3. HCI – An Overview http://www.ee.cityu.edu.hk/~hcso/ee4213_ch1.pdf

Online Courses and Video Lectures

1. "Human-Computer Interaction", https://nptel.ac.in/courses/106/103/106103115/ Accessed on July 9, 2021
2. "Introduction to Human Computer Interaction", https://nptel.ac.in/courses/106/106/106106177/ Accessed on July 9, 2021
3. "Human-Computer Interaction" https://swayam.gov.in/nd1_noc19_cs86/preview Accessed on July 9, 2021

Subject Code: PECS-124

Subject Name: Deep Learning

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Course Status:** Elective

Prerequisite: complete knowledge of Clustering, Classification and Graphical Models

CO #	Course Outcomes (CO)
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.

Detailed Contents:

PART-A

Introduction: Deep Learning definition, why Deep Learning, history of Deep Learning, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Convergence theorem for Perceptron Learning Algorithm. **[5 Hours]**

Feedforward Networks: Multilayer Perceptron, Representation power of Feedforward Neural Networks, Backpropagation Gradient Descent, Empirical Risk Minimization, autoencoders. **[4 Hours]**

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training, Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, **[5 Hours]**

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs **[5 Hours]**

Part-B

Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet **[6 Hours]**

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines. **[5 Hours]**

Recent trends: Variational Autoencoders, Auto-encoders and unsupervised learning, Stacked auto-encoders and semi-supervised learning, transfer learning, multi-model learning, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning **[6 Hours]**

Textbooks

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

2. Bengio, Yoshua. "Learning deep architectures for AI", Foundations and trends in Machine Learning 2.1 (2009):

Reference Books

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996

2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

E-books and online learning material

1. http://deeplearning.net/tutorial/deeplearning.pdf

2. http://neuralnetworksanddeeplearning.com/index.html

3. https://d2l.ai/d2l-en.pdf

Online Courses and Video Lectures

1. "Deep Learning", https://nptel.ac.in/courses/106/106/106106184/ Accessed on July 9, 2021

2. "Deep Learning for Visual Computing", https://nptel.ac.in/courses/108/105/108105103/

   Accessed on July 9, 2021

Subject Code: LPECS-111

Subject Name: Soft Computing Laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 7	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.

On completion of the course, the student will have the ability to:

CO#	Course Outcome
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.

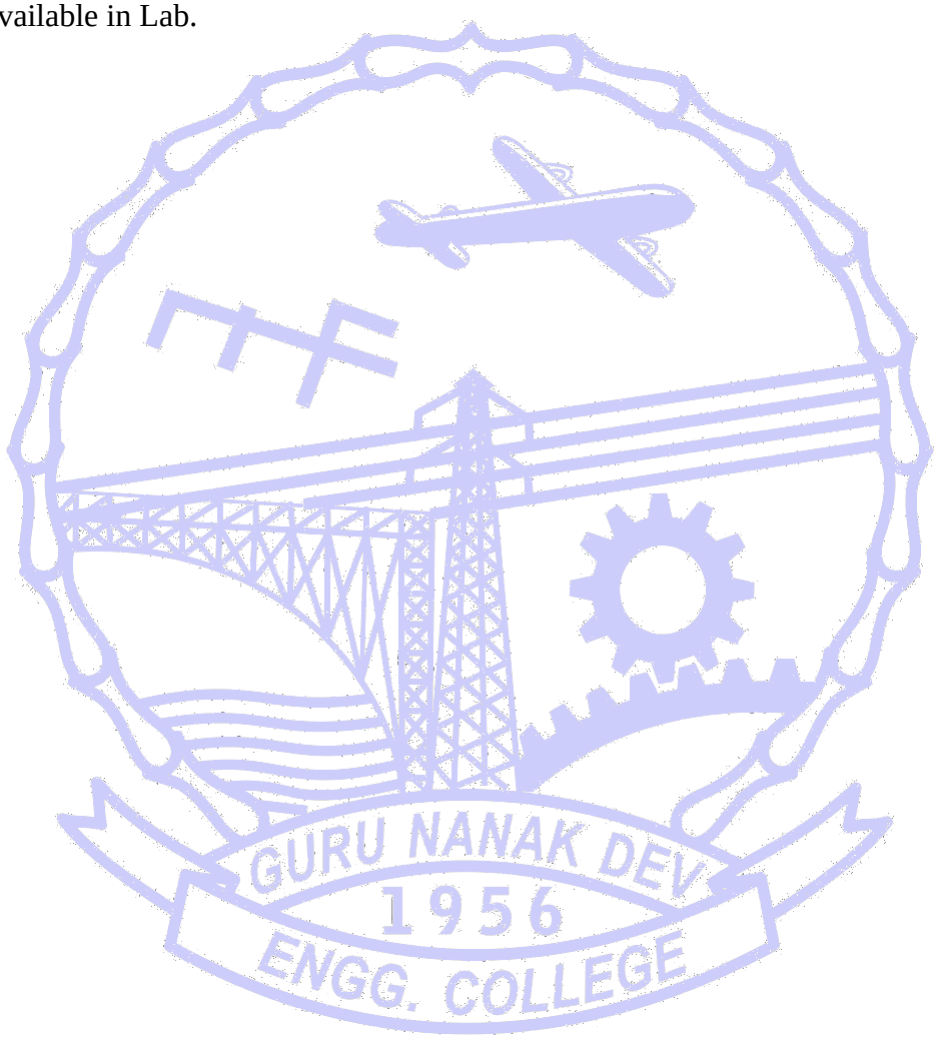
List of Practicals

1. Study and Analysis of Fuzzy vs Crisp Logic.
2. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
3. Study and Analysis of Genetic Algorithm Life Cycle.
4. Write a Program for Implementing TSP using GA.
5. Write a Program of Perceptron Training Algorithm.
6. Write a Program to Implement Hebb's Rule.
7. Write a Program to Implement Delta Rule.
8. Write a Program for Back Propagation Algorithm.
9. Write a Program For Error Back Propagation Algorithm (EBPA) Learning.
10. Study and Analysis of Counter Propagation Network (CPN).

Project: Students are required to develop a solution for practically complex real life problems; like for a production system or a medical diagnosis expert system or just creating a simple ADALINE network with appropriate no. of input and output nodes and further train it using delta/Hebb learning rule until no change in weights is required and calculating its final weights, and implementation of neural/fuzzy network.

Reference Material

Manuals available in Lab.



Subject Code: LPECS-112

Subject Name: Deep Learning Laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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 deep ne 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.

List of Practicals

1. Learn to build your first simple neural network and analyse it using some real data.
2. Build recurrent networks and long short-term memory networks and perform sentiment analysis on it.
3. Build a ResNet architecture and use it for some real-world data.
4. Implement AlexNet architecture and use it for image database.
5. Implement a 2-D CNN and use it for speech data corpus.
6. Implement a hybrid network using CNN and LSTM and use it for classification.
7. Use deep neural networks to design agents that can learn to take actions in a simulated environment. Apply reinforcement learning to complex control tasks like video games and robotics.
8. Build a pair of multi-layer neural networks and make them compete against each other in order to generate new, realistic faces.

Reference Material

Manuals available in Lab.

Subject Code: - PCES-128
Subject Name: Web Technologies

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 7	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Course Status: Elective**

Prerequisites: Knowledge of basic programming skills

Additional Material Allowed in ESE: - NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
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.

Detailed Contents

PART-A

Introduction: History and evolution of Internet protocols, Internet addressing, Internet Service Provider (ISP), Introduction to WWW, DNS, URLS, HTTP, HTTPS, SSL, Web browsers, Cookies, Web servers, Proxy servers, Web applications. **[6 Hours]**

HTML: Introduction to HTML and HTML5, History of HTML, Structure of HTML Document: Text Basics, Structure of HTML Document: Images, Multimedia, Links, Audio, Video, Table and Forms, Document Layout, HTML vs. HTML5, Meta tags, and Website structure. **[7 Hours]**

Style Sheets: Need for CSS, Introduction to CSS, Basic syntax and structure, Types of CSS– Inline, Internal and External CSS style sheets. CSS Properties - Background images, Colors and properties, Text Formatting, Margin, Padding, Positioning, CSS3 – Animation, Page Structure, Responsive Design, Framework – Twitter Bootstrap **[5 Hours]**

PART - B

JavaScript: Introduction, JavaScript's history and versions, Basic syntax, Variables, Data types,

Statements, Operators, Functions, Arrays, Objects, Dialog boxes, JavaScript DOM, JavaScript Validations, Overview of AngularJS and NodeJS. **[6 Hours]**

PHP and MySQL: Introduction and basic syntax -of PHP, Data types, Variables, Decision and looping with examples, String, Functions, Array, Form processing, Cookies and Sessions Management, E-mail, PHP-MySQL: Connection to server, Creating database, Selecting a database, Listing database, Listing table names, Creating a table, inserting data, altering tables, queries, Deleting database, Deleting data and tables, and Overview of Model View Controller platform **[8 Hours]**

Search Engine Optimization: Deploying a website on server, Search engine optimization and its different types, Web application testing and security, Web APIs **[4 Hours]**

Text Books

1. DT Editorial Services, "Web Technologies, Black Book, 2018", 1st Edition, Dreamtech Press.
2. Rajkamal, "Internet and Web Technology", 1st Edition, Tata McGraw Hill.
3. Ray Rischpater, "JavaScript JSON Cookbook", 1st Edition, Packt Publishing,
4. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering Html, Css & Javascript", 1st Edition BPB Publications,

Reference Books

1. Ivan Bayross, "Web Enabled Commercial Application Development using HTML, DHTML JavaScript, Perl, CGI", 4th Edition, BPB Publications.
2. Peter Moulding, "PHP Black Book", 1st Edition , Coriolis,

E-Books and Online learning material

1. Twitter Bootstrap https://www.syncfusion.com/succinctly-free-ebooks/twitterbootstrap4-succinctly/the-grids-the-grids-the-beautiful-grids
2. PHP Programming https://en.wikibooks.org/wiki/PHP_Programming
3. HTML and CSS https://wtf.tw/ref/duckett.pdf
4. Search Engine Optimization https://static.googleusercontent.com/media/www.google.com/sk//webmasters/docs/search-engine-optimization-starter-guide.pdf

Online Courses and Video Lectures

1. "Web Design for Beginners", https://www.udemy.com/share/1013yI/ Accessed on August 30, 2021
2. "Building web applications in PHP", https://www.coursera.org/learn/web-applications-php Accessed on August 30, 2021

Subject Code: PECS-125

Subject Name: Parallel and Distributed Algorithms

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Course Status:** Elective

Prerequisites: Knowledge of Parallel and Distributed Computing Algorithms

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES (CO)
CO1	Understand and learn parallel and distributed algorithms development techniques for memory and message passing models
CO2	Study the main classes of parallel algorithms.
CO3	Analyse 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.

Detailed Contents:

Part-A

Introduction: The Idea of Parallelism, Parallel Computing, Models of computation, Parallel Algorithms analysis, Parallel Algorithms models, Design Techniques, Matrix Multiplication, Sorting, Parallel Search Algorithm, Graph Algorithms. **[5 Hours]**

PRAM Algorithms: PRAM Model of Parallel Computation, Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging Two Sorted Lists, Graph Coloring, Reducing the Number of Processors and Brent's Theorem, Dichotomoy of Parallel Computing Platforms, Cost of Communication. **[6 Hours]**

Pipeline Processing: Introduction, Pipeline Performance, Arithmetic Pipelines, Pipelined Instruction Processing, Pipeline Stage Design, Hazards, Dynamic Instruction Scheduling. **[6 Hours]**

Part-B

Synchronous Parallel Processing: Introduction, Example-SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, Data Mapping and scheduling in array processors. **[6 Hours]**

Distributed Algorithms: Definition, Issues, Goals, Types of distributed systems, Distributed System Models and complexity measures, Distributed Graph algorithms, Safety, liveness, termination, logical time and event ordering, Global state and snapshot algorithms, Mutual exclusion. **[5 Hours]**

Synchronization: Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure, Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala's Algorithm, Maekawa's Algorithm, Token Based Algorithms: Suzuki-Kasami's Broadcast Algorithms, Singhal's Heurastic Algorithm, Raymond's Tree based Algorithm, Comparative Performance Analysis. **[8 Hours]**

Text Books

1. Michael J Quinn, "Parallel Computing: Theory and Practice", second edition, McGraw Hill.
2. Joseph Jaja, "An Introduction to Parallel Algorithms", second edition, Addison-Wesley/Pearson.

Reference Books:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", second edition, Addison-Wesley/Pearson.
2. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems", first edition, TMH.

Subject Code: PECS-130

Subject Name: Mobile Application Development

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 8	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Status:** Elective

Prerequisites: Programming in Java

Additional Material Allowed in ESE: - NIL

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES
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.

Detailed Contents

PART-A

Introduction: Introduction to mobile applications, Market and business drivers for mobile applications, Publishing and delivery of mobile applications, Requirements gathering and validation for mobile applications, Different types of Mobile Applications – Native Application Development and Hybrid Mobile Application Development. **[6 Hours]**

Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file. **[6 Hours]**

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions. **[6 Hours]**

PART-B

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation, Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources. **[5 Hours]**

Using Common Android APIs: Using Android Data and Storage APIs, managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs. **[3 Hours]**

iOS: Introduction to iOS, XCode and Swift, Architecture of Swift, Conditional Statement & Operators, Loops. **[4 Hours]**

React Native: Introduction to React and React Native, Architecture of React Native, Working with content, Navigation, Statement Management in React Components **[6 Hours]**

Text Books

1. Jeff McWherter, "Professional Mobile Application Development 1st Edition", Wrox
2. John R. Carlson Ph.D., "Cross-Platform Mobile Application Development: A Beginner's Guide Using Solar2D", Independently published
3. S. Sydhani Begum, "Mobile App Development - Android Programs Using Eclipse: Android Programs Using Eclipse Indigo", Notion Press

Reference Books

1. Gookin, "Android For Dummies, 2nd Edition", For Dummies
2. Adam Boduch, "React and React Native: A complete hands-on guide to modern web and mobile development with React.js, 3rd Edition", Packt Publishing

E-Books and Online learning material

1. Android https://books.goalkicker.com/AndroidBook/
2. React Native https://allitbooks.net/programming/82-react-native-action.html

Online Courses and Video Lectures

1. "The Complete React Native + Hooks Course", https://www.udemy.com/share/101Wbw/ Accessed on July 09, 2021
2. "The Complete Android N Developer Course", https://www.udemy.com/share/101Wfk/ Accessed on July 09, 2021
3. "Advanced App Development in Android Specialization"https://www.coursera.org/specializations/advanced-app-android Accessed on July 09, 2021

Subject Code: - LPECS-114

Subject Name: Web Technologies Laboratory

Programme: B.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 7th	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Knowledge of basic programming skills

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES (CO)
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

List of Practicals

1. Check and List down Government guidelines for creating a website.

2. Configuration and administration Apache Web Server.

3. Develop an HTML page to demonstrate the use of basic HTML tags, Link to different HTML page and also link within a page, insertion of images and creation of tables.

4. Develop a registration form by using various form elements like input box, text area, radio buttons, check boxes etc.

5. Design an HTML page by using the concept of internal, inline, external style sheets.

6. Create an HTML file to implement the styles related to text, fonts, links using cascading style sheets.

7. Create an HTML file to implement the concept of document object model using JavaScript

8. Create an HTML page including JavaScript that takes a given set of integer numbers and shows them after sorting in descending order.

9. Write an HTML page including any required JavaScript that takes a number from one text field in the range of 0 to 999 and shows it in another text field in words. If the number is out of range, it should show "out of range" and if it is not a number, it should show "not a number" message in the result box.

10. Create a PHP file to print any text using variable.

11. Demonstrate the use of Loops and arrays in PHP

12. Create a PHP file using GET and POST methods.

13. A simple calculator web application that takes two numbers and an operator (+, -, /, * and %) from an HTML page and returns the result page with the operation performed on the operands.

14. Implement login page contains the user name and the password of the user to authenticate with Session using PHP and MySQL, also implement this with the help of PHP-Ajax.

15. A web application for implementation:

    a. The user is first served a login page which takes user's name and password. After submitting the details the server checks these values against the data from a database and takes the following decisions.

    b. If name and password matches, serves a welcome page with user's full name.

    c. If name matches and password doesn't match, then serves "password mismatch" page

    d. If name is not found in the database, serves a registration page, where user's full name is asked and on submitting the full name, it stores, the login name, password and full name in the database (hint: use session for storing the submitted login name and password)

16. Minor project using different technologies studied.

Reference Material

Manuals available in Lab.

Subject Code: - LPECS-115
Subject Name: Mobile Application Development Laboratory

Programme: B.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Elective

Prerequisites: Programming in Java

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES (CO)
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

List of Practicals

1. Create working environment – Installation of Android SDK.
2. Create an application that uses GUI Components, Fonts and Colors.
3. Create an application that uses Layout Managers and Event Listeners.
4. Create a calculator application.
5. Create an application that makes use of database.
6. Create an application that uses GPS location information.
7. Write a code that draws basic graphical primitives on the screen.
8. Create an application that makes use of RSS Feed.
9. Create an application that creates an alert upon receiving a message.
10. Create an application that writes data to the SD card.

Reference Material

Manuals available in Lab.

Subject Code: PRCS-106
Subject Name: Technical Aptitude

Programme: B.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 0	**Duration of End Semester Exam (ESE): NA**
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Knowledge of core subjects

On completion of the course, the student will have the ability to:

Detailed Contents:

The course aims to make students industry ready with technical expertise and to conduct research-based projects. The course is offered in the final year as a refresher course and during the period they shall be prepared for various competitive exams. The students shall be prepared on various core areas of Computer Science and Engineering such as Data Structures, Digital Logic, Higher Level programming constructs, Compilers and Algorithms; Operating Systems; Computer Networks; Databases; Data Analytics; Graphics Processor Unit; Computer and data security; Program Verification.

Subject Code: PRCS-107
Subject Name: Software Management Tools

Programme: B.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 8	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 0	**Duration of End Semester Exam (ESE): NA**
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Knowledge of basic programming skills

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES (CO)
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.

Detailed Contents:

To provide the hands-on experience in managing various software projects. In this lab, students are required to work on various open-source software management tools like Github, OpenProj, Bugzilla, Jenkins, Harvest, WinRunner and tools of CICD (DEV or UAT) etc. for planning, managing, analyzing, designing, testing and implementing various software projects based on the platform used from the developer as well as client point of view. Languages they have learned so far. Therefore, based on the software requirement, project management reports should be prepared under the guidance of faculty coordinator.