Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET601T	Digital Communication	3	1	0	4	40	60	100	3

Course Objective
Course is intended to provide fundamental concepts and techniques of digital communication for enhancing technical skills and solving real life problems to boost employability.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Understand:** Understand basic building blocks of digital communication system and line coding techniques for digital signal.
CO2	**Apply:** Apply the concepts of probability theory to model digital communication system using appropriate mathematical techniques.
CO3	**Evaluate:** Analyze performance of different digital communication systems and evaluate their performance in terms of bit error rate.
CO4	**Apply:** Interpret and apply channel coding techniques to detect and correct errors for the reliable communication.
CO5	**Apply:** Comprehend and apply the concept of multiplexing for various applications of communication systems.

SYLLABUS

UNIT I: Introduction to Digital Communication System

Functional blocks of digital communication system, Source encoder and decoder, Channel encoder and decoder, Modulator and demodulator.

Line Coding: Need for Line Coding, Properties of Line Coding, Unipolar Return-to-Zero (RZ) and Non-Return-to-Zero (NRZ), Polar RZ and NRZ, Bipolar NRZ, Split Phase Manchester Coding, Polar Quaternary NRZ Coding, High Density Bipolar Order-3 Coding, Scrambler and Unscrambler.

UNIT II: Fundamentals of Probability Theory & Random Processes
Concept of probability, Random variable, Statistical averages, Correlation, Central Limit Theorem, Random process, Classification of random processes, Power spectral density, Multiple random processes.

UNIT III: Digital Carrier Modulation
Introduction to Carrier Modulation, Amplitude Shift Keying (ASK), Binary Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), Frequency-shift keying (FSK), M-ary PSK, M-ary FSK, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK) and Gaussian Minimum Shift Keying (GMSK), Differential encoding and decoding.

UNIT IV: Information Theory and Source Coding
Information Theory: Measure of information, Entropy and information rate; Discrete communication channel: Noiseless, Deterministic, Binary Symmetric; Rate of information transfer, Discrete memoryless channel, Continuous communication channel: Shannon Hartley Theorem, Additive White Guassian Noise; Signal to Noise Ratio, Source encoding: Huffman algorithm, Shannon's algorithm, Shannon- Fano algorithm.

UNIT V: Error Control Coding
Channel coding theorem, Linear block codes, Hamming codes, Cyclic codes, Convolutional codes, Viterbi decoder.

UNIT VI: Spread Spectrum Methods
PN sequences, Direct sequence methods, Frequency hop methods, Digital spread spectrum, performance analysis, Synchronization methods, Application of spread spectrum, Code Division Multiple Access.

Text Books Recommended

1. "Digital Communications", John Proakis and Masoud Salehi, 5th Edition, 2018,McGraw Hills.
2. "Digital communications", Simon Haykin, Student Edition, 2013, John Wiley.

Reference Books Recommended

1. "Digital and Analog Communication Systems", K. Sam Shanmugam, 1st Edition, 2006, John Wiley & Sons.
2. "Modern Digital and Analog Communication Systems", B. P. Lathi, 4th Edition, 2011, Oxford Press Publication.
3. "Communication Systems Analog and Digital", Singh, Sapre, 3rd Edition, 2017, McGraw Hill Edu.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET602T	Control System Engineering	3	1	0	4	40	60	100	3

Course Objective
The course is intended to impart skills for analyzing and designing of physical systems (LTI systems) by deriving their mathematical models.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Apply:** Apply the knowledge of mathematics and engineering sciences to derive the mathematical models of physical systems.
CO2	**Analyze:** Analyze the behavior of LTI Systems in time domain and determine system stability.
CO3	**Analyze:** Analyze a control system by using various graphical methods such as Root Locus, Bode Plot, Polar Plot and Nyquist Plot.
CO4	**Analyze:** Model and analyze the control systems using state model.
CO5	**Apply:** Interpret and apply the analysis techniques for digital control systems.

SYLLABUS

UNIT I: Fundamentals of Control Systems and System Modeling

Basic elements in control systems, Classification of control systems, Open loop and closed loop systems, Transfer function, Block diagram algebra, Signal flow graph, Mathematical modeling of physical systems: Electrical, Mechanical, Electro-mechanical systems; Analogous systems, Effect of parameter variation in open loop and closed loop systems, Sensitivity.

UNIT II: Time Domain Analysis

Concept of time response, Transient and Steady state responses, Standard test signals, Transfer function and Time response of first and second order systems, Steady state error (ess) analysis: Static error constant method and Dynamic error constant method; Dominant poles, Transient response: Characteristic equation,

Damping ratio, Time domain specifications, Introduction to Proportional (P), Integral (I), Derivative (D) and Rate feedback controllers.

UNIT III: Stability and Root Locus Technique

Stability Assessment: Introduction, Concept, Characteristic equation, Location of poles, Routh and Hurwitz criterion; Root Locus: Introduction , Magnitude and angle criteria, Properties, Construction rules for negative feedback systems, Gain from root locus, Effect of addition of open loop poles and zeros on root locus.

UNIT IV: Frequency Domain Analysis

Concept of frequency response, Sinusoidal transfer function, Bode plot, Polar plot, Nyquist stability criterion, Correlation between frequency domain and time domain specifications, Stability analysis.

UNIT V: State Space Analysis

Concept of state, State variables and state model, State space modeling of linear systems: Phase variable method, Canonical variable method, Physical variable method; Transfer function from state model, Stability from state model.

UNIT VI: Digital Control Systems

Introduction, Advantages over analog control system, Sampled data control system, Transfer function, Step response (First & second order systems only), Introduction to Digital PID Controller, Introduction to PLC: Block schematic, PLC addressing, Application of PLC using Ladder diagram.

Text Books Recommended

1. "Control Systems Engineering", I.J. Nagarth and M.Gopal, 6th Edition, 2017, New Age International.
2. "Discrete Time Control System", K. Ogata, 2nd Edition, 2005, Prentice Hall of India.

Reference Books Recommended

1. "Automatic Control Systems", Benjamin C. Kuo, 7th Edition, 2003, Prentice Hall of India.
2. "Control Systems-Principles and Design", M. Gopal, 4th Edition, 2012, Tata Mc-Graw Hill.
3. "Control Systems Engineering" R. Anandanatarajan, P. Ramesh Babu, 5th Edition, 2018, Scitech Publications Pvt. Ltd.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET603T	Computer Communication Networks	3	0	0	3	40	60	100	3

Course Objective
The course is proposed to make students understand network layered architecture and protocol stack for the design and analysis of computer networks to boost employability and entrepreneurship.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Understand:** Comprehend the basic concepts of computer networks and reference models.
CO2	**Analyze:** Interpret and analyze multiple access control, switching and routing techniques used in computer networks.
CO3	**Apply:** Understand and apply error control, flow control and congestion control techniques.
CO4	**Analyze:** Analyze various standards and protocols used in different layers of computer networks.
CO5	**Apply:** Recognize and apply the concepts of network security to conceal the vital information in computer communication network.

SYLLABUS

UNIT I: Fundamentals of Computer Networks and Physical Layer

Introduction, Topology, Network types, Connection and connectionless oriented services, OSI reference model, TCP/IP reference model, Physical Layer: Performance, Transmission media, Switching techniques, Cable modem and DSL technologies.

UNIT II: Data Link Layer and Media Access

Design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols, HDLC.

MAC Layer: Channel allocations, Multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth.

UNIT III: Network Layer

Network layer design issues, Routing algorithms, Congestion control algorithms, Internetworking, IPv4, IPv6, Quality of Service.

UNIT IV: Transport Layer

Transport layer design issues, Process to Process communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Stream Control Transmission Protocol (SCTP), Congestion Control, Quality of Service, Techniques to improve QoS: Leaky Bucket and Token Bucket algorithm.
Exposure to implementation of protocols using modern simulation tools.

UNIT V: Application Layer

Domain Name System (DNS), Electronic mail, World Wide Web: Architectural overview, Dynamic web document and http;Application Layer Protocols: Simple Network Management Protocol (SNMP), File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), Telnet.
Implementation of protocols using modern simulation tools.

UNIT VI: Cryptography and Wireless Networks

Principles of cryptography, Security and cryptography algorithms, Authentication, Key distribution and certification, Symmetric key algorithm, Public key algorithm; Wireless network security, IEEE 802.11 wireless LAN overview, IEEE 802.11i wireless LAN security, WAP end-to-end security, Wireless Standards: GSM, GPRS, WCDMA, LTE, WiMAX.

Text Books Recommended

1. "Data communication and Networking", Behrouz A. Forouzan, 5th Edition, 2017, Mc Graw-Hill Education.
2. "Computer Networking: A Top Down Approach", James F. Kurose, Keith W. Ross, 6th Edition, 2013, Pearson Publication

Reference Books Recommended

1. "Computer Networks", A. S. Tanenbaum, 6th Edition, 2022, Pearson Education.
2. "Computer Networks and Cryptography", William Stallings, 7th Edition, 2017, Pearson Education.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET603P	Computer Communication Networks Lab	0	0	2	1	25	25	50	-

Course Objective
The course is intended to develop computer communication networks designing and troubleshooting skills using modern tools to improve employability.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Apply:** Select and apply different components required to establish computer communication networks.
CO2	**Analyze:** Configure, simulate and analyze different types of networks based on the given requirements.
CO3	**Evaluate:** Implement and evaluate performance of different network protocols used in network architecture model.

Sr. No.	List of Experiments
	Pre Lab An Introduction to Computer Communication Lab: • Demonstration of Network Hardware components - Cables, NIC, RJ-45, Crimping tool, Repeaters, Hubs, Bridges, Switches and Routers.
1	Implementation of cross-wired cable and straight through cable using crimping tool.
2	Demonstration of formation of Local Area Network.
3	Demonstration of different network diagnostics commands.
4	Installation of TCP/IP protocol configuration and study the classification of addresses employing TCP/IP protocols.
5	Simulation of simple network of two nodes using modern simulation tool.
6	Implementation of different network topologies using modern simulation tool.

7	Verification of TCP protocol using modern simulation tool.
8	Verification of UDP protocol using modern simulation tool.
9	Implementation of Distance-vector routing protocol using modern simulation tool.
10	Implementation of AODV routing protocol using modern simulation tool.
11	Implementation of EIGRP for automating routing decisions and configuration protocol using modern simulation tool.
12	Implementation of OSPF (link-state routing protocol) using modern simulation tool.
13	Configure a Network Router.
14	Understand IP address of the system and Network Address Translation.
15	Exposure to Domain Name Server (DNS).
	Post Lab
16	Mini Project: Implementation of BGP Protocol using modern simulation tool.
17	Mini Project: Implement OSPF (link-state routing protocol) using network simulator ns-2.
18	Open Ended Experiment.

NOTE: Minimum Eight experiments to be performed based on above list.

Suggested References

1. "Data Communications and Networking", Behrouz A. Forouzan, 5th Edition, 2017, Tata McGraw Hill.
2. "Computer Networks", Andrew Tanenbaum, 6th Edition, 2022, Pearson Education.
3. "Computer Networking: A Top Down Approach", James F. Kurose, Keith W. Ross, 6th Edition, 2013, Pearson Publication

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET604T	Digital System Design	3	0	0	3	40	60	100	3

Course Objective
The course is envisioned to endow the concepts of hardware description language for the design and implementation of digital systems to boost the employability and entrepreneurship.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Apply:** Interpret and apply the concept of hardware description language.
CO2	**Analyze:** Apply, analyze and simulate different modeling styles for design of combinational and sequential circuits.
CO3	**Create:** Identify the needs and devise systems for real life applications.
CO4	**Evaluate:** Compare and evaluate different architectures of PLD's to implement digital systems.

SYLLABUS

UNIT I: Fundamentals of Hardware Description Language (HDL)
Introduction, Design flow, Design methodologies, Hardware abstraction, Design units, Basic VHDL elements, Identifiers, Delays, IEEE standard logic library, Data objects, Data types, Operators.

UNIT II: Dataflow and Structural Modeling
Conditional signal assignment statements, Selected signal assignment statements, Concurrent signal assignment statement, Concurrent Vs. Sequential signal assignment, Block statement, Concurrent assertion statement, Structural Modeling: Component declaration, Component instantiation, Resolving signal values, Configuration.
Exposure to modern simulation tool for designing digital systems.

UNIT III: Behavioral Modeling Process statement, Variable, Sequential signal assignment, Wait, If statement, Case statement, NULL statement, LOOP statement, Exit statement, Next statement, Assertion and Report statements, Multiple processes, Design of Sequential Circuits: Flip flops, Shift Registers and Counters.
UNIT IV: Subprogram Functions, Procedures, Attributes, Generic, Generate, Package, Text file for input and output, Test bench.
UNIT V: Finite State Machine (FSM) Overview, FSM representation, Moore machine Vs. Mealy machine, VHDL representation of FSM, State assignment, Design examples.
UNIT VI: Programmable Logic Devices Concepts and generic architecture of PAL, PLA, PLD,CPLD and FPGA's, Synthesis and Implementation of Boolean functions using programmable logic devices, Design Examples: ALU, Barrel shifter, Keyboard scanner, Multiplier.

Text Books Recommended
1. "VHDL: Programming by Example", Douglas Perry, 4th Edition, 2002, McGraw Hill Education.
2. "VHDL Primer", J. Bhasker, 3rd Edition, 2015, Pearson Education.
3. "VHDL: A Design Oriented Approach", Dr. S. S. Limaye, 1st Edition, 2009, McGraw Hill Publications.

Reference Books Recommended
1. "Digital System Design Using VHDL", Charles H. Roth, 3rd Edition, 2016, McGraw Hill Publications.
2. "Fundamentals of Digital Logic with VHDL Design", Stephen Brown & Zvonko Vranesic, 4th Edition, 2022, TMH Publications.
3. "VHDL: Analysis and Modelling of Digital Systems", Zainalabedin Navabbi, 2nd Edition, 1998, McGraw Hill publication.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET604P	Digital System Design Lab	0	0	2	1	25	25	50	-

Course Objective
The course is intended to provide knowledge of hardware description language for the design and simulation of digital systems using modern simulation tools to enhance employability.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Apply**: Model, simulate and implement the digital systems using Hardware Description Language.
CO2	**Create**: Design digital systems using generic, generate and assignment statements.
CO3	**Create**: Design and analyze FSM for sequence generators and detectors.

Sr. No.	List of Experiments
	Pre Lab • Introduction to simulation tool. • Introduction to DE2 board. • Introduction to FPGA board.
1	Design & simulation of Logic gates and verify it using test bench.
2	Write a VHDL dataflow program for Half Adder, Half Subtractor and verify it using test bench.
3	Design and simulation of binary to gray code converter and verify it using test bench.
4	Using conditional signal assignment statement write a VHDL program for 4:1 MUX, 2:4 Decoder and Full Adder.

5	Design & simulation of 8:3 Priority Encoder and verify it using test bench.
6	Design & simulation of flip/flops and verify it using test bench.
7	Write behavioral VHDL program for 4-bit Shift register.
8	Write structural VHDL program for Full Adder using Half Adder and 16:1 MUX using 4:1 MUX.
9	Design and implementation of BCD to 7-Segment decoder on Altera Terasic DE2 development board.
10	Design and implementation of Arithmetic Logic Unit (ALU) and verify it using test bench.
11	Design & simulation of up-down counter and verify it using test bench.
12	Design and implementation of 4 bit Barrel Shifter and verify it using test bench.
13	Design and simulation of Mealy and Moore machine to detect the sequence 1101 and verification using test bench.
14	Design and simulation of 3 bit Multiplier and verify it using test bench.
15	Design a RAM using VHDL.
16	Develop VHDL program for I/O read and Write.
17	Using Generate Statement write a VHDL program for 8 Bit Adder using full Adders.
Post Lab	
18	Mini Project

NOTE: Minimum Eight experiments to be performed based on above list.

Suggested References

1. "VHDL: Programming by Example", Douglas Perry, 4th Edition, 2002, TMH Publications.
2. "VHDL Primer", J. Bhasker, 3rd Edition, 2015, Pearson Education.
3. "VHDL: A Design Oriented Approach", Dr. S. S. Limaye, 1st Edition, 2009, McGraw Hill Publications.
4. User manual: http://www.ece.tufts.edu/~hchang/ee129-f06/project/project2/DE2_UserManual.pdf

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCET605P	Software Workshop Lab	0	0	4	2	25	25	50	-

Course Objective

The course is intended to empower the learners to apply the concepts of Structured Query Language, SciPy Library, Data Processing and Visualization using Python to design and develop applications that enhances their development skills and employability.

Course Outcomes

After successful completion of this course, students will be able to:

CO1	**Apply:** Apply the elements of SQL to create and access databases for applications.
CO2	**Analyze**: Apply and analyze the constructs of SciPy Library to provide solutions to given problem statements.
CO3	**Apply:** Apply data processing and visualization techniques to the given data sets.
CO4	**Create:** Design and develop web applications using python package "streamlit".

SYLLABUS

MODULE-I: Basic Structured Query Language

Introduction, Installation, CRUD Operations, Relational databases, Single Table CRUD, Data models and Relational SQL: Designing a data model and its representation, Inserting relational data, Reconstruction Data with JOIN; Many-to-Many Relationships, Databases & Visualisation: Geocoding, Geocoding Visualisation.

MODULE II: Scientific Computation using Python

Introduction, Environment setup, Basic functionality, Cluster, Constants, FFTpack, Integrate, Interpolate, Linalg, Ndimage, Optimize, Stats, CSGraph, Spatial, ODR, Special Packages.

MODULE III: Data Processing & Visualisation Pandas: Introduction, Series, Dataframes, Loading Data, Data Filtering, Data Extraction, Working with Text Data, MultiIndex, Grouping, Merging, Concatenation; Matplotlib: Introduction, Different Matplotlib charts, Customization Options, Graphical plotting using Basemap, 3D Graphing.
MODULE IV: Application Development using "Streamlit" Introduction, Basic features, Environment setup, Packages, App Skeleton, Menu, beta_columns, beta_expanders, Summarization, Text cleaning, Tokens, Lemmas, Deployment of Streamlit Share.

Suggested References
1. "SQL and Python Programming", Bryan Johnson, 1st Edition, 2019, KDP Print US.
2. "SciPy and NumPy", Eli Bressert, 2nd Edition, 2013, O'Reilly Media, Inc.
3. "Getting Started with Streamlit for Data Science", Tyler Richards, 1st Edition, 2021, Packt Publishing.

NOTE: Minimum Eight Practicals to be performed covering the above complete syllabus of the course [PCCET605P].

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PECET601T	VLSI Signal Processing	3	0	0	3	40	60	100	3

Course Objective
The course is intended to provide in-depth knowledge of digital signal processing in VLSI architecture to inculcate skills for optimizing area, power & speed of systems and enhance employability.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Understand:** Acquire knowledge of pipelining and parallel processing to optimize VLSI design.
CO2	**Apply:** Apply the concepts of retiming to increase processing speed and reduce power consumption of the DSP architecture.
CO3	**Analyze:** Apply and analyze various algorithms to reduce complexity of the design.
CO4	**Create:** Design of control circuits using folding techniques for hardware optimization.
CO5	**Create:** Design and develop real time DSP module using pipelining, parallel processing, unfolding and folding techniques.

SYLLABUS
Unit I: Pipelining and Parallel Processing Introduction, Pipelining of FIR digital filters, Parallel processing, Pipelining and parallel processing for low power systems. *FIR filters realization using HDL.*
Unit II: Retiming Introduction, Concepts, Properties, Solving system of inequalities, Retiming techniques.
Unit III: Unfolding Introduction, Algorithms for unfolding, Properties of unfolding, Critical path, Unfolding and retiming, Applications of unfolding.

Unit IV: Folding Introduction, Folding Transformation, Register minimization in folded architectures, Folding in Multirate systems.
Unit V: Fast Convolution-I Introduction, Cook- Toom algorithm, Modified Cook- Toom algorithm, Winograd algorithm, Modified Winograd algorithm. *Implementation of Modified Cook Toom algorithm using HDL.*
Unit VI: Fast Convolution-II Iterated Convolution, Cyclic Convolution, Design of Fast Convolution Algorithm by Inspection.

Text Books Recommended
1. "VLSI Digital Signal Processing Systems", Keshab K. Parhi, Student Edition, 2018, Wiley-Inter Sciences.

Reference Books Recommended
1. "Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing", Jose E. Franca, Yannis Tsividis, 1993, Pearson.
2. "Analog VLSI Signal and Information Processing", Mohammed Ismail, Terri, Fiez, 1994, McGraw Hill.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PECET602T	Embedded Systems & RTOS	3	0	0	3	40	60	100	3

Course Objective
The course is intended to provide in-depth knowledge, techniques and skills of embedded system for designing real life applications to enhance employability and entrepreneurship.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Apply:** Comprehend and apply the concepts of embedded system in the field of engineering and industrial applications.
CO2	**Apply:** Apply programming skills to develop embedded solutions.
CO3	**Analyze**: Apply and analyze different communication protocols in embedded applications.
CO4	**Apply:** Understand and apply RTOS concepts for real time scheduling.

SYLLABUS

UNIT I: Embedded System and Architecture

Introduction, Embedded systems Vs. General computing systems, Classification, Design challenges, Design metric, Embedded product development life cycle, Processor selection, Memory architecture, I/O devices.

UNIT II: ARM Processor

Introduction, Architecture, Register Set, Modes of operation, overview of Instructions and software routine development.

Initialization of ARM inbuilt peripherals using embedded C.

UNIT III: Interrupts and Device Drivers

Exceptions and interrupt handling schemes, Context & Periods for context switching, Deadline & interrupt latency, Device drivers.

UNIT IV: Communication Protocols Serial and Parallel communication, Serial communication protocols: RS232, SPI, I2C, USB, Bluetooth, ZigBee; Parallel port programming: MODBUS, CAN.
UNIT V: Real Time Operating System (RTOS) Basics of Operating System, Types of Operating Systems, Tasks, Process, Threads, Multiprocessing and Multitasking, Task scheduling, Deadlocks.
UNIT VI: Task Communication Shared memory, Message passing, Remote procedure call and sockets, Task synchronization: Task communication synchronization issues, Task synchronization techniques.

Text Books Recommended
1. "Embedded Systems-Architecture, Programming and Design", Raj Kamal, 3rd Edition, 2017, McGraw Hill Education.
2. "Introduction to Embedded Systems", K.V. Shibu, 2nd Edition, 2017, McGraw Hill Education.
3. "Embedded Systems an Integrated Approach", Lyla B Das, 1st Edition, 2012, Pearson.
4. "ARM System–on-chip Architecture", Steve Furber, 2nd Edition, 2012, Pearson Publisher.

Reference Books Recommended
1. "Embedded / Real-Time Systems", Dr. K.V.K. Prasad, 1st Edition, 2003, Dreamtech Press.
2. "Embedded System Design", Steve Heath, 2nd Edition, 2003, Neuwans Publications.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PECET603T	Data Science	3	0	0	3	40	60	100	03

Course Objective
The course is proposed to enhance quantitative modeling and data analysis skills to solve real world problems and effectively demonstrate results using data visualization skills so as to enhance employability and entrepreneurship.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Analyze**: Acquire the knowledge of data science and perform data analysis to build data processing model.
CO2	**Analyze**: Interpret and analyze big data using visualization techniques.
CO3	**Apply**: Interpret and apply statistical methods to the large datasets for extracting required information.
CO4	**Analyze**: Apply and analyze various similarities and distance measuring techniques to classify the data.

SYLLABUS

Unit I: Fundamentals of Data Science

Introduction, Data sources, Challenges, Applications, Big data overview, Data analytics, Business Intelligence (BI) Vs. Data Science, Analytical architecture, Tools of big data, Emerging big data ecosystem, Data Analytic Life Cycle: Overview, Discovery, Data preparation, Model planning, Model building, Communicate Results, Operationalization.

Unit II: Data Analysis

Data types, Data preparation, Data cleaning, Data analysis, Data interpretation, Data models & data integration.

Unit III: Data Visualization

Overview, Types, Techniques and Tools for data visualization, Data visualization: Numerical, Non-

Numerical, Visualization Dashboard.
Data visualization using modern simulation tools.

Unit IV: Linear Algebra and Statistical Inference
Linear algebra for data science: Matrix, Rank, Null space, Eigenvalue decomposition; Statistical methods for evaluation, Mean, Mode, Median, Random variables: Continuous, Discrete; Expected value, Correlation, Variance, Standard deviation, Errors, Regression: Linear, Logistic.

Unit V: Statistical Distribution and Evaluation
Statistical Distribution Methods: Bernoulli, Gaussian, Normal, Binomial, Poisson, Chi-Square; Statistical Evaluation Methods: Hypothesis testing, Wilcoxon rank–sum test, type 1 & type 2 errors, Power and sample size, ANNOVA.
Statistical analysis of Big data using modern tools.

Unit VI: Similarity & Distance Measuring Techniques
Similarity Measuring Techniques: Shingling, Min-hashing, Locality sensitive hashing; Distance Measuring Techniques: Triangle inequality, Euclidean distance, Cosine distance, Jaccard distance, Edit distance measures.

Text Books Recommended

1. "Data Science & Big Data Analytics", David Dietrich, Barry Hiller, 6th Edition, 2015, Wiley Publications.
2. "Applied Statistics and Probability for Engineers", Douglas C. Montgomery, George C. Runger, 5th Edition, 2011, John Wiley & Sons, Inc.

Reference Books Recommended

1. "Doing Data Science", Cathy O'Neil and Rachel Schutt, 1st Edition, 2013 , O'Reilly Media Inc.
2. "Data Science from Scratch First Principles with Python", Joel Grus, 2nd Edition, 2019, O'Reilly Media.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
OECET601T	System Design using Raspberry-pi	3	0	0	3	40	60	100	03

Course Objective
The course is intended to provide the concepts of operating systems, programming skills and communication protocols of Raspberry-pi to foster the employability and entrepreneurship.

Course Outcomes	
After successful completion of this course, students will be able to:	
CO1	**Understand**: Understand the working principle of Raspberry Pi and its various components.
CO2	**Apply**: Make use of operating system and programming concept to develop applications.
CO3	**Analyze**: Analyze wired and wireless communication protocols for implementation of system using Raspberry pi.
CO4	**Apply**: Apply IoT design concepts to develop applications using sensors and Raspberry pi.

SYLLABUS

Unit I: Fundamentals of Raspberry pi

Introduction, Comparison of various Raspberry pi models, SoC architecture in Raspberry Pi, Pin configuration, On-board components.

Unit II: Raspberry Pi Operating System

Linux: Introduction, Architecture, File system; Raspbian: Introduction, Leafpad editor; First boot, basic configuration, Popular linux commands.

Exposure to Raspbian: Installation and Application building.

Unit III: Python Programming forRaspberry Pi

Libraries, GPIO Programming Examples: LED, Switches, Seven segment display, LCD, Stepper motor.

Unit IV: Communication Protocols

Wired and Wireless communication, TCP/IP configuration, Putty terminal usage, GSM interfacing, Accessing on-board Wi-Fi, Connecting database with Raspberry Pi.

Unit V: Sensor Interfacing

Sensors Interfacing: Temperature, Humidity, Motion, Sound, Ultrasonic, Flame; Camera interfacing, Automation using Raspberry Pi.

Exposure to modern simulation tools for prototype development.

Unit VI: IoT Design

LAMP Web-server, GPIO control over web browser, Creating custom web page for LAMP, Communicating data using on-board module, Node-RED, MQTT Protocol, Visual Editor, IoT Applications based on Raspberry Pi.

Text Books Recommended

1. "The Official Raspberry Pi Beginner's Guide", Gareth Halfacree, 4th Edition, 2020, Raspberry Pi Trading Ltd.

Reference Books Recommended

1. "Raspberry Pi User Guide", Eben Upton, Gareth Halfacree, 4th Edition, 2016, Wiley Publications.
2. "Programming the Raspberry Pi: Getting started with Python", Simon Monk, 3rd Edition, 2021, McGraw-Hill Education.