Curriculum for UG Degree Course in B. Tech. Electronics and Telecommunication Engineering
(Academic Year: 2024-25 Onwards)

Semester-IV

Course Code	Course Title	Teaching Scheme Hours / Week			Cr	Examination Scheme			Total Marks
		L	T	P		ISE	ESE	Pr/Or	
23PCEC401	Digital Communication	3	0	0	3	50	50	0	100
23PCEC402	Sensors and Actuators	2	0	0	2	25	25	0	50
23PCEC403	Machine Learning	3	0	0	3	50	50	0	100
23CEP401	Community Engagement Project	1	0	2	2	50	0	0	50
23MmEC401	Statistical Analysis for Healthcare Data	3	1	0	4	50	50	0	100
23VSECEC401	Object Oriented Programming Lab.	0	0	4	2	25	0	25	50
23EEM401	Entrepreneurship *[Entrepreneurship/Economics/Management Courses]*	3	1	0	4	50	50	0	100
23PCEC401L	Digital Communication Lab	0	0	2	1	0	0	25	25
23PCEC403L	Machine Learning Lab	0	0	2	1	0	0	25	25
	Total =	15	02	10	22	300	225	75	600

L=Lecture, T=Tutorial, P= Practical, Cr= Credits, ISE =In Semester Evaluation, ESE =End Semester Examination, Pr/Or = Practical/Oral

CUMMINS COLLEGE OF ENGINEERING FOR WOMEN ★ KARVE NAGAR, PUNE-411052

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Secretary Academic Council
MKSSS's Cummins College of Engineering
For Women, Pune-411052

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23PCEC401 DIGITAL COMMUNICATION

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: Principles of Communication Systems

Course Objectives:

1 Explain Baseband and Bandpass modulation techniques.
2 Explain the conversion of digital data to digital signal for reliable baseband transmission.
3 Describe the principle of spread spectrum modulation including pseudo noise sequence.
4 Introduce basic concepts of information theory and source coding techniques.

Course Outcomes:

After completion of the course, students will be able to

CO1 Illustrate digital representation of message signal with and without modulation
CO2 Interpret the techniques for digital transmission of signals and information theory concepts
CO3 Apply source coding techniques for data compression
CO4 Analyse Baseband, Bandpass and Spread spectrum techniques for the transmission of digital signals

Unit I: Digital Transmission of Analog Signal

Comparison between analog and digital communication, Block diagram of digital communication system, Sampling Process, Pulse Code Modulation Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, Delta Modulation, Adaptive Delta Modulation, Differential Pulse Code Modulation.

Unit II: Baseband Digital Transmission

Digital Multiplexing: Multiplexers and hierarchies, Data formats, Bit and Frame Synchronization, Scramblers, Inter-symbol interference, Equalization, Eye diagram.

Unit III: Bandpass digital Techniques

Binary phase shift keying, Differential phase shift keying, Quadrature phase shift keying, M-ary phase shift keying, Quadrature Amplitude shift keying, Binary frequency shift keying, M-ary frequency shift keying, Minimum shift keying, Introduction to Gaussian Minimum shift keying.

Unit IV: Spread Spectrum Techniques

Pseudo noise sequence generator, Properties of PN sequence, Direct sequence spread spectrum with coherent Binary Phase Shift Keying, Processing gain, Jamming margin, Frequency hop spread spectrum: Slow frequency hopping and Fast frequency hopping.

Unit V: Information Theory and Source Coding

Introduction to information theory, Entropy and its properties, Source coding theorem, Shannon-Fano coding, Huffman coding, Lempel-Ziv algorithm, Discrete memory less channels and Mutual information, Channel capacity, Channel coding theorem, Information Capacity theorem.

Text Books:

1. Donald L. Schilling, Goutam Saha, Herbert Taub, "Principles of Communication system", T*ata McGraw-Hill Education Pvt. Ltd*, (4th Edition), (2015).
2. Ranjan Bose, "Information Theory Coding and Cryptography", Tata McGraw- Hill, (3rd Edition), (2016).

Reference Books:

1. Simon Haykin, Michael Moher, "Communication Systems", *Wiley*, (5th Edition), (2009).
2. T. L. Singal, "Digital Communication", *Tata McGraw-Hill*, (1st Edition), (2012).
3. A. B. *Carlson* and P. B. Crilly, "Communication Systems", *McGraw-Hill*, (5th Edition), (2002).

Online Resources:

1. NPTEL "Introduction to Digital Communication" https://nptel.ac.in/courses/117101051/
2. NPTEL "An introduction to Coding theory" https://nptel.ac.in/courses/108/104/108104092/

23PCEC402 SENSORS AND ACTUATORS

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
End Semester: 25 Marks
Credits: 2

Prerequisite: Basic Science, Basic Electronics, ECA

Course Objectives:
1. Explain real-life applications of Sensors and Actuators
2. Interpret characteristics and specifications of Sensors and Actuators
3. Analysis characteristics and select Sensors and Actuators
4. Make use of Sensors and Actuators to design microcontroller-based systems

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain the working principles of sensors and actuators
CO2 Select appropriate sensors and actuators for given applications
CO3 Analyze characteristics of sensors and actuators
CO4 Make use of sensors and actuators with a Controller module for real-life applications

Unit I: Sensors and Transducers
Introduction to Sensors and Transducer, Classification of Sensors, Measurement and Characteristics of sensors, data sheet interpretation, sensors used for physical parameter measurement, MEMS Sensors

Unit II: Position, Displacement, and Level Sensors
Limit switch, Proximity sensors, Inductive, capacitive, Magnetic, IR and Ultrasonic;
Displacement: - Potentiometer, Optical Encoders, LVDT, RVDT and Ultrasonics sensors;
Level: - Resistive, Capacitive, IR, and Ultrasound sensors.

Unit III: Actuators
Definition, types and selection of Actuators, Linear and rotary Actuators, Electric actuators, working principles of solenoid, relay and Motors, AC Motors, Types of DC Motors: - Permanent Magnet and Field Magnet DC Motors, BLDC Motors, DC Servo Motors, Stepper Motors; Specification and Selection Criteria, Application of Electric Actuators.

Unit IV: Interfacing Sensors and Actuators with Controller Module
Need for Signal Conditioning, interfacing of analog and digital sensors modules with Arduino/NodeMCU, Need of Drivers for Electric Actuators, Interfacing of electric actuators with Arduino/NodeMCU.

Text Books:

1. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010.
2. Patranabis. D, "Sensors and Transducers", Wheeler publisher, 1994.
3. Tero Karvinen, Kimmo Karvinen, "Make: Arduino Bots and Gadgets", Released March 2011, Publisher(s): Make: Community

Reference Books:

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002
2. A. K. Sawhney. "A Course in Electronics Measurement and Instrumentation", Dhanpat Rai and Son, 2021.

Online Resources:

1. onlinecourses.nptel.ac.in/noc24_ee45/course

23PCEC403 MACHINE LEARNING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: Linear Algebra, Probability and Statistics, Calculus

Course Objectives:

1. To explain the basic machine learning concepts and algorithms
2. To illustrate the basic machine learning design flow
3. To implement machine learning algorithms for regression, classification, and clustering problems
4. To analyze the evaluation metrics for the machine learning algorithm

Course Outcomes:

After completion of the course, students will be able to:

CO1 Elaborate machine learning concepts and algorithms
CO2 Interpret machine learning design flow
CO3 Apply machine learning concepts and algorithms for regression, classification, and clustering problems
CO4 Analyse the performance of machine learning algorithms

Unit I: Fundamentals of Machine Learning

Basic concepts in machine learning, Parametric and non-parametric modelling, Overfitting and Underfitting, Feature selection, Dimensionality reduction techniques- PCA, LDA, Training, Testing and Validation errors, Confusion matrix and Evaluation Parameters

Unit II: Regression

Introduction to Regression, Simple linear regression, Multiple linear regression, Non-Linear Regression, and Evaluation metrics in regression models.

Unit III: Classification

Introduction to Classification, K-Nearest Neighbours, Decision Trees and Random Forest Algorithm, Logistic Regression, Logistic Regression vs Linear Regression, Support Vector Machine, Introduction to Bayesian Probability, Naive Bayes algorithm, Evaluation metrics in classification.

Unit IV: Clustering

Introduction to Clustering, K-Means Clustering, Hierarchical Clustering and Density-Based Spatial Clustering of Applications with Noise (DBSCAN) Clustering.

Text Books:

1. S. Sridhar, M. Vijayalaxmi, **"Machine Learning"**, *Oxford University Press, (1st Edition)* (2021)
2. Vinod Chandra S. S., Anand Hareendran S., **"Artificial Intelligence and Machine learning"**, *PHI, (1st Edition)* (2014).

Reference Books:

1. Chris Albon, **"Machine Learning with Python Cookbook"**, *O'Reilly Media, Inc., (1st Edition)*, (2018).
2. Aurélien Géron, **"Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow"**, *O' Reilly Media, Inc., (2nd Edition)*, (2019).
3. Kevin Murphy, **"Machine Learning: A Probabilistic Perspective"**, *MIT Press, (1st Edition)*, (2012).

Online Resources:

1. NPTEL Course **"Introduction to Machine Learning"**
   https://onlinecourses.nptel.ac.in/noc24_cs51/
2. NPTEL Course **"Machine Learning for Engineering and Science Applications"**
   https://onlinecourses.nptel.ac.in/noc24_cs38/

23CEP401 COMMUNITY ENGAGEMENT PROJECT

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 50 Marks

Credits: 2

Course Outcomes:
After completion of the course, students will be able to

CO1	CO1: To define problem statement for identified community
CO2	CO2: To select method for data collection
CO3	CO3: To analyze the collected data
CO4	CO4: To conclude / summarize overall learning from the project and communicate it to the stakeholders

In this course, students will identify a significant challenge/problem faced by a certain community, apply a systematic approach to investigate the problem, conduct field visits to collect relevant data, analyze the collected data, summarize their findings and compile a detailed report about their study. This report may be presented to the stakeholders.

Pedagogy:

- In-class activity: Group discussions, interaction with faculty mentor
- Out-of-the-class activity: Field visits, interaction with community, data collection

23MmEC401 STATISTICAL ANALYSIS for HEALTHCARE DATA

Teaching Scheme
Lectures: 3 Hours / Week
Tutorial: 1 hour/week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 4

Course Objectives:

1. Introduce Statistical Measures and Data Analysis
2. Discuss Random variables and Distributions
3. Explore statistical tests
4. Explore multivariate analysis

Course Outcomes:

After completion of the course, students will be able to

1. Compute statistical measures for healthcare data
2. Apply probability distribution models for healthcare data
3. Analyze healthcare data using hypothesis tests
4. Analyze healthcare data using multivariate analysis techniques

Unit I: Statistical Measures for Healthcare Data

Measures of Central Tendency: Weighted Arithmetic Mean, Geometric mean, Harmonic Mean, quartiles. Measures of Variation: Quartile Deviation, Standard Deviations, Coefficient of Variation. Measurement of Skewness. Exploratory data analysis of healthcare data.

Unit II: Random Variables and Probability Distributions

Basics of probability, Random variable Concept, Distribution Function, Density Function, Probability Distributions: Binomial, Poisson, Normal, Uniform, Rayleigh. Operations on Random variables: Expectation, Moments, Random process concept, Stationary and Independence.

Unit III: Tests of Hypotheses

Parametric and nonparametric tests, Tests of Hypothesis Concerning Means, Hypothesis Concerning Proportions, Hypothesis Concerning Variations (Chi-square and F-Tests), Chi-square Test for checking Independent of Categorized Data, Goodness of Fit Test, Analysis of Variance (ANOVA).

Unit IV: Multivariate Statistical Analysis

Introduction, Correlation Analysis, correlation coefficient, Rank correlation, Autocorrelation, Forecasting such as simple moving average, weighted moving average, simple exponential smoothing method.

Text Books:

1. Ronald E. Walpole, Raymond H. Myers, **"Probability and Statistics for Engineers and Scientists",** *Pearson Education*, (9th Edition), (2012).
2. R. Panneerselvam, **"Research Methodology"**, *PHI Learning Private Limited*, (2nd edition), (2014).

Reference Books:

1. S. M. Ross, **"Introduction to Probability and Statistics for Engineers and Scientists"**, *Elsevier Publication*, (5th Edition), (2014).
2. Jay I. Devore, **"Probability and Statistics for Engineers and Scientists"**, *Elsevier Publication*, (5th Edition), (2014).

3. Kellar, S.P. & Kelvin, E. A., "Munro's Statistical Methods for Health Care Research", (6th ed). Kluwer Health, Lippincott Williams, and Wilkins (2013).

Online Resources:

1 NPTEL Course: **"Probability and Statistics"** https://nptel.ac.in/courses/111/105/111105090/

23VSECEC401 OBJECT ORIENTED PROGRAMMING LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Sem Exam: 25 Marks
Practical Exam: 25 Marks
Credits: 2

Course Objectives:

1. To interpret basic constructs of Java
2. To understand the concepts of classes and objects in Java
3. To understand the String class and exception handling in Java
4. To understand Inheritance and its types

Course Outcomes:

After completion of the course, students will be able to:

CO1 Implement programs in Java utilizing the basic constructs.
CO2 Apply the concepts of Encapsulation and instances.
CO3 Utilize the concepts of the String class and Inheritance.
CO4 Apply the concept of exception handling and multithreading.

List of Experiments:

1. Programs to show key features of the Java Language:
   a) Addition of 2 numbers without and with the use of scanner class
   b) Demonstrate simple use of **if** statement and **for** loop
   c) Program to find sum and average of 'n' numbers

2. Programs to show Java's fundamental elements: Data types, variables and arrays
   a) Demonstrate **char** variables and **Boolean** values
   b) Demonstrate Dynamic initialization, scope and lifetime of variables
   c) Demonstrate single and two-dimensional arrays

3. Programs to showcase Java operators:
   a) Arithmetic, Modulus, Increment and Decrement operators.
   b) Bitwise and Boolean logical operators
   c) Ternary operator

4. Programs to use Classes, objects and methods – [A progressive approach]:
   a) Program with class and object/s
   b) Introducing Methods and returning a value
   c) Constructors – Default and Parameterized, use of ***this*** keyword
   d) To implement a calculator with arithmetic operations such as add, subtract, multiply, divide and factorial using switch case and constructors.

5. A closer look at Methods and Classes:
   a) Program to demonstrate method overloading
   b) Passing Objects to Methods
   c) Understanding Static

6. Exploring the String Class:

a) Program to demonstrate Strings.
b) Show use of different arithmetic operators using charAt( ) method.
c) Command Line arguments.

7. Program to define a class rectangle with the data fields width, length, area and colour. Create two objects of rectangle and compare their area and colour.

8. Program to sort
   i) List of integers
   ii) List of names

9. Program to add two matrices.

10. Inheritance:
    a) Program on simple inheritance
    b) Program to demonstrate Member access and inheritance
    c) Program to demonstrate multilevel inheritance without and with the use of the keyword ***super***
    d) Program to demonstrate Method Overriding.

11. Program to incorporate Exception Handling.

12. Write a program to demonstrate deadlock in multithreading

23EEM401 ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme
Lectures: 3 Hours / Week
Tutorial: 1 hour/week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 4

Course Objectives: Students will be able to

1. Understand the fit between individual entrepreneurial ambitions and select a problem worth solving
2. Identify customers and create value proposition
3. Identify direct and indirect competitors and prepare business model
4. Build and demonstrate an MVP (Minimum Viable product) and financial plan
5. Identify appropriate GTM Channels
6. Prepare growth plan along with possible funding options

Course Outcomes:
After completion of the course, students will be able to

1. Identify entrepreneurial opportunities and develop entrepreneurial skills
2. Analyze the customer segments and create a compelling value proposition for solution
3. Develop Business Model along with Minimum Viable Product for testing
4. Create a Pitch deck with effective presentation

Unit I: Entrepreneurship foundation
Entrepreneurship and Intrapreneurship, why startup fails, Mindset, skillset, entrepreneurial styles, discover yourself, Principles of Effectuation, problem identification and opportunity discovery, problem worth solving analysis and validation, idea validation.

Unit II: Value proposition
Customer segments, market identification and sizing, primary and secondary research, customer journey mapping, market validation, brainstorming ideas, innovative solution, Problem- solution fit, compelling value proposition, sustainable differentiation, competition analysis, pricing models, competitive advantage.

Unit III: Business model canvas
Lean business model, test assumptions, identify risks, risk mitigation strategy, MVP and testing MVP, refining MVP, business plan: financial, sales, people. unit economics, identify matrix that matters, feasibility analysis.

Unit IV: Goto market strategy
Channel identification, key partnerships, marketing strategy, Pricing strategy, Effective marketing plan, digital marketing. building traction, feedback, refining MVP, Product-market fit, refining business model and strategy.

Unit V: Support systems and business regulations

business entities, organization structure and functional requirements, agreements, regulations and permissions, business ethics, startup ecosystem, incubation centers and accelerators, Government initiatives, local initiatives, IPR strategy, role of technology.

Unit VI: Pitch deck and growth plan

Effective pitch deck, contents of presentation, growth plan, scaling strategy, 5 years plan, creating pitch deck, Sources of funds, term sheet and contracts, equity, execution plan, team building, time management and work delegation, business partner and employee dilemma, acquisition, and mergers.

Textbooks:

1. "Entrepreneurship Journey from Idea to Startup" by Dr. Makarand Ramesh Velankar, Dr. Megha Sunil Borse, Dr. Anjali Milind Naik Techknowledge Publications, 2024
2. Course contents will be available on https://wadhwanifoundation.org/programs/ignite/

Reference Books:

1. Harvard business review entrepreneur's handbook
2. Traction: A Startup Guide to Getting Customers by Gabriel Weinberg and Justin Mares

Online Resources:

1 https://wadhwanifoundation.org/programs/ignite/

23PCEC401L DIGITAL COMMUNICATION LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
Oral: 25 Marks

Credits: 1

Course Objectives:

1. Explain waveform coding techniques such as Pulse Code Modulation, Delta Modulation, and Adaptive Delta Modulation.
2. Understand data formats.
3. Describe the digital modulation techniques.
4. Explain the direct sequence spread spectrum technique.
5. Introduce the concept of source coding techniques for data compression.

Course Outcomes:

After completion of the course, students will be able to

CO1 Measure performance parameters of waveform coding techniques.
CO2 Simulate data format techniques.
CO3 Compare and measure bit rate of digital modulation techniques.
CO4 Interpret the PN sequence generation and spread spectrum techniques.
CO5 Apply source coding techniques for data compression.

List of Experiments:

1. To simulate the Sampling theorem.
2. To measure Bit rate, Signal to noise ratio and Quantization error for PCM.
3. To measure slope overload in delta modulation and observe granular noise in delta modulation and adaptive delta modulation.
4. To simulate data format techniques. (Unipolar NRZ, Unipolar RZ, Polar NRZ, Polar RZ, Bipolar NRZ(AMI), Manchester).
5. To simulate Amplitude shift keying, Phase shift keying and Frequency shift keying binary digital modulation techniques.
6. To measure and compare bit rate of BPSK and QPSK.
7. To study spectral analysis of Direct sequence spread spectrum with binary phase shift keying.
8. To simulate Data compression techniques.

23PCEC403L MACHINE LEARNING LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
Oral: 25 Marks

Credits: 1

Course Objectives:

1. To demonstrate data visualization and summary statistics for data understanding
2. To demonstrate the regression algorithms for real-world societal problem
3. To demonstrate the classification algorithms for real-world societal problem
4. To demonstrate the clustering algorithms for real-world societal problem

Course Outcomes:

After completion of the course, students will be able to;

CO1 Apply data visualization and statistical summary to understand the data
CO2 Implement a regression algorithm to solve a real-world problem
CO3 Implement a classification algorithm to solve a real-world problem
CO4 Implement a clustering algorithm to solve a real-world problem

List of Experiments:

1. Accessing the dataset
2. Data visualisation and calculating the statistical summary
3. Regression algorithm for real-world application
4. Logistic regression algorithm for real-world application
5. Naive Bayes algorithm for real-world application
6. Decision tree/random forest algorithm for real-world application
7. Clustering algorithm for real-world application