Cummins College of Engineering for Women

(An autonomous institute affiliated to Savitribai Phule pune university)

Karve Nagar, Pune - 411 052.

Vision

To be globally renowned engineering institute for imparting holistic education and developing professional women leaders in engineering and technology

Syllabus Structure and Syllabus

of

T. Y. B.Tech.
(Electronics and Telecommunication Engineering)

2023 Pattern [R0]

List of Abbreviations

Abbreviation	Title
PCC	Programme Core Course
BSC	Basic Science Course
ESC	Engineering Science Course
PE	Programme Elective Course
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
CC	Co-curricular Courses / Liberal Learning Course
IKS	Indian Knowledge System
VEC	Value Education Course
RM	Research Methodology
INTR	Internship
PROJ	Project
CEP	Community Engagement Project
RM	Research Methodology
Mm	Multidisciplinary Minor
AEC	Ability Enhancement course

Curriculum for UG Degree Course in B. Tech. Electronics and Telecommunication Engineering
(Academic Year: 2025-26 Onwards)

Semester-V

Course Code	Course Title	Teaching Scheme Hours / Week			Cr	Examination Scheme			Total Marks
		L	T	P		ISE	ESE	Pr/Or	
23PCEC501	VLSI Design	3	0	0	3	50	50	0	100
23PCEC502	Digital Image Processing	2	0	0	2	25	25	0	50
23PCEC503	Digital Signal Processing	3	1	0	4	50	50	0	100
23PCEC504	Microcontroller and Applications	3	0	0	3	50	50	0	100
23PEEC501	Programme Elective-I	3	0	0	3	50	50	0	100
23MmEC501	Biomedical Signal Acquisition and Data Analysis	3	0	0	3	50	50	0	100
23PCEC501L	VLSI Design Lab	0	0	2	1	25	0	25	50
23PCEC503L	Microcontroller and Applications Lab	0	0	2	1	25	0	25	50
23PEEC501L	Programme Elective-I Lab	0	0	2	1	25	0	25	50
23MmEC501L	Biomedical Signal Acquisition and Data Analysis Lab	0	0	2	1	25	0	25	50
	Total =	17	01	08	22	375	275	100	750

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

Programme Elective-I		Programme Elective-I Lab	
23PEEC501A	DBMS	23PEEC501LA	DBMS Lab
23PEEC501B	Mobile communication	23PEEC501LB	Mobile Communication Lab
23PEEC501C	Internet of Things	23PEEC501LC	Internet of Things Lab
23PEEC501D	Introduction to Hydraulic Systems	23PEEC501LD	Introduction to Hydraulic Systems Lab

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

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23PCEC501 VLSI DESIGN

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. To introduce VLSI Design Flow
2. To explain the design hierarchy, syntax, lexical conventions, data types, and modeling styles in Verilog
3. To illustrate the design and implementation of digital circuits using Verilog
4. To elaborate on the FPGA architecture
5. To illustrate the design of digital circuits using CMOS logic

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain the fundamental concepts of VLSI design
CO2 Describe the syntax, semantics, and structure of Verilog HDL for digital circuit design
CO3 Analyze digital systems design using Verilog HDL
CO4 Analyze the architecture of the FPGA for logic synthesis
CO5 Analyze CMOS digital circuits in terms of their functionality

Unit I: Introduction to VLSI Design

Evolution of IC Technology, VLSI Design Flow, ASIC and Its Types, Overview of Mobile SoC, EDA Tools Used in VLSI. Physical IC Design steps, Timing and Clock Tree synthesis**,** Power Planning, IC Fabrication process, Applications of VLSI IC.

Unit II: Verilog HDL

Lexical conventions, Data types, System tasks, Compiler directives, Expressions, Operators, Operands in Verilog, Modules and Ports, Gate-Level Modeling, Dataflow Modeling, Behavioral Modeling, Structural modeling, Switch level modeling.

Unit III: Modeling a Digital System Using HDL

Structured procedures, Initial and always, blocking and non-blocking statements, Delay control, Conditional statements, Multiway branching, Loops, Sequential and parallel blocks, tasks and functions. Digital circuit design using FSM (Moore and Mealy Machine), Case studies for Societal & Security applications.

Unit IV: Design and Synthesis with FPGA

Spectrum of PLDs, ASIC Vs FPGA Design flow, Architecture of FPGA, Programming Technologies, Dedicated Components in FPGA, Implementing logic in FPGA, Metastability, Specification and Application of FPGA, Design for synthesis, Synthesis of Case statement, Unintentional latch creation, Synthesis of if statement, Hardware-Software Co-design Overview

Unit V: Digital CMOS Circuit

CMOS Inverter, Inverter VTC, Power Dissipation, Technology Scaling, MOSFET parasitic, Transmission gates, Lambda Design Rules, CMOS combinational logic design. CMOS sequential logic design. Introduction to Fin-FET, Semiconductor Memories

Text Books:

1. S. Palnitkar, **"Verilog HDL – A Guide to Digital Design and Synthesis",** *Pearson Publication,* (3rd Edition), (2010).
2. Neil H. E. Weste, David Money Harris, **"CMOS VLSI Design: A Circuit & System Perspective",** *Pearson Publication,* (4th Edition), (2010).
3. Pong P. Chu, "**FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version**", *Wiley-Interscience*, (1st Edition), (2008).

Reference Books:

1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "**Digital System Design using Verilog**", *Cengage India Private Limited*, (1st Edition), (2017).
2. Wyane Wolf, **"Modern VLSI Design (System on Chip)",** *PHI Publication,* (3rd Edition), (2002).
3. Stephen Brown, Zvonko Vranesic, "**Fundamentals of Digital Logic with Verilog Design"**, *McGraw-Hill Education*, (3rd Edition), (2013).
4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "CMOS Digital Integrated Circuits, Analysis and Design" McGraw-Hill Education, (4thEdition), (2019).

Online Resources:

1. NPTEL Course **"Hardware modeling usingVerilog"**
   https://onlinecourses.nptel.ac.in/noc23_cs76/preview
2. NPTEL Course **" CMOS Digital VLSI Design"**
   https://onlinecourses.nptel.ac.in/noc24_ee29/preview
3. NPTEL Course "VLSI Physical Design with Timing Analysis"
   https://onlinecourses.nptel.ac.in/noc24_ee77/preview

23PCEC502 DIGITAL IMAGE PROCESSING

Teaching Scheme
Lectures: 2 Hours / Week

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

Prerequisite: Calculus and Probability, Signals and Systems.

Course Objectives:

1 To understand the basic concepts of image processing, like relations between pixels, distance measures, statistical parameters, colour models, and operations on images.
2 To study different image enhancement, segmentation, and representation techniques.
3 To study image analysis in spatial and transform domains for image compression.
4 To study different applications of Image processing.

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain the fundamental concepts of image processing
CO2 Apply image processing techniques for image compression and representation
CO3 Analyse image processing techniques for image enhancement and segmentation
CO4 Design an image processing system for real-life applications.

Unit I: Digital Image Fundamentals

Element of Visual Perception, Types of images, Sampling and Quantization, Relationship between pixels and distance measures, Statistical parameters, Basic operations, Morphological operations on images, Colour models, and Converting colours to different models.

Unit II: Image Enhancement and Image Compression

Image Enhancement in Spatial Domain, Basic Gray Level transformations, Histogram, Histogram equalization, Contrast stretching, Gray level slicing, Basics of Spatial Filtering, Smoothing filters, Sharpening filters, Need for compression, Data Redundancies, Lossy and Lossless compression, Discrete Cosine Transform, JPEG compression.

Unit III: Image Segmentation and Representation

Image segmentation, Thresholding, Region-based segmentation, Region growing, Splitting and Merging, Image representation, Segmented image representation by RL code, Chain codes, and Shape number.

Unit IV: Applications of Image Processing

Basic block diagram of image processing, Fingerprint recognition, Character recognition, Face recognition, Remote sensing, and QR code processing.

Text Books:

1. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson Education, (2nd Edition), (2012).

2. S. Jayaraman, Esakkirajan, Veerakumar, "Digital Image Processing", McGraw-Hill Education, (1st Edition), (2012).

Reference Books:

1. Anil Jain, "Fundamentals of Digital Image Processing", Prentice Hall, (1st Edition), (1989).
2. Pratt W. K, "Digital Image Processing", John Wiley, (2nd Edition), (2001).

Online Resources:

1. NPTEL Course "Digital Image Processing" http://nptel.ac.in/courses/117/105/117105135/
2. NPTEL Course "Digital Image Processing" https://nptel.ac.in/courses/117/105/117105079/

23PCEC503 DIGITAL SIGNAL PROCESSING

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. To understand fundamental DSP concepts and applications of DSP.
2. To apply transform techniques for the analysis of signals.
3. To analyze digital filter design techniques.
4. To understand digital signal processor architecture.

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

CO1	Apply the sampling theorem for the conversion of analog signals to discrete-time signals
CO2	Apply transform techniques to analyze signals in the frequency domain
CO3	Design FIR and IIR digital filters for the given specifications
CO4	Analyze DSP techniques for real-world signal processing problems
CO5	Explain the architectural features of DSP processors and design issues

Unit I: Introduction to Digital Signal Processing
Basic elements of DSP, Sampling of analog signals, Conversion of continuous time to discrete-time signals, Need for sampling rate conversion, Sampling rate conversion- Upsampling and Downsampling, Applications of DSP- Audio Processing, Speech Processing, Biomedical Processing, Telecommunication.

Unit II: Transform Techniques
Discrete Fourier Transform (DFT), Need of DFT, Properties of DFT, Decimation-in-Time and Decimation-in-Frequency Radix-2 Fast Fourier Transform (FFT) algorithms, Short-time Fourier transform, Wavelet transform, Applications of transform techniques.

Unit III: FIR Filter Design
Comparison of analog and digital filters, Types of Finite Impulse Response (FIR) filters, Design of linear phase FIR filter using the windowing method, Characteristics and comparison of different window functions, FIR filter structures-Direct and Cascade forms.

Unit IV: IIR Filter Design
Characteristics of ideal and practical frequency-selective filters, Comparison of characteristics of-Butterworth, Chebyshev and elliptic filters, Design of Infinite Impulse Response (IIR) filters, IIR filter design by impulse invariance and bilinear transformation methods, IIR filter structures- Direct form I and II.

Unit V: Digital Signal Processors
Basic architectural features of DSP processors, Comparison of general-purpose CPU and DSP processors, DSP computational building blocks, Applications of real-time signal processing.

Text Books:

1. John G. Proakis, D. G. Manolakis, **"Digital Signal Processing"**, *Pearson Prentice Hall*, (4th Edition).
2. A. Nagoor Kani, **"Digital Signal Processing"**, *Tata McGraw-Hill*, (2nd Edition).
3. Emmanuel C. Ifeachor, B. W. Jervis, **"Digital Signal Processing—A Practical Approach,"** *Pearson Education,* (2nd Edition).

Reference Books:

1. S. Salivahanan, **"Digital Signal Processing"**, *McGraw-Hill,* (3rd Edition).
2. Alan V. Oppenheim, **"Discrete-Time Signal Processing"**, *Pearson Education India*, (2nd Edition).
3. Li Tan, **"Digital Signal Processing Fundamentals and Applications"**, *Academic Press*, (2008).

Online Resources:

1. NPTEL Course: Digital Signal Processing and Its Applications
   https://nptel.ac.in/courses/108101174
2. NPTEL Course: Signal Processing Techniques and Its Applications
   https://onlinecourses.nptel.ac.in/noc22_ee62/

23PCEC504 MICROCONTROLLER AND APPLICATIONS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1. To explain the applications of microprocessors and microcontrollers.
2. To introduce the architecture and features of typical microcontrollers.
3. To interface real-world, I/O devices
4. To explain hardware and software development tools

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe the architecture of microcontrollers
CO2 Analyze algorithms for interfacing on-chip and off-chip peripherals
CO3 Analyze the microcontroller-based hardware circuit and debug the software program
CO4 Design a microcontroller-based system for real-life applications

Unit I: Introduction to Embedded Systems

Embedded system: Need of Embedded System - Applications, Classification and working of Embedded System (block diagram), Embedded system characteristics, Microprocessors and Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Architecture of a Microcontroller, Microcontroller Family, Microcontroller selection process for application, Microcontroller Application Development tools: Simulator, Emulator, ISP, Cross assembler.

Unit II: Microcontroller Architecture

Microcontroller architecture, Pin configuration, RESET, Crystal interface, Program Status Word (PSW), Internal memory organisation, Port Structure: GPIO LED interface, Stack and Stack Pointer, Serial communication: Concept of RS 232C.

Unit III: On-chip Peripherals

Microcontroller On-chip peripherals: Counters/Timers, ADC and DAC, Interrupts.

Unit IV: Interfacing External Peripherals

Interfacing LCD, switch, Stepper motor, Relays, buzzer, and DC servo motor control using PWM.

Unit V: Sensor Interface

Interfacing and calibrating sensors: Accelerometer, Gas sensor, Temperature and Humidity Sensor: DHT-11, Float sensor, Gyro sensor.

Unit VI: Microcontroller Applications

Case studies: Design a Minimum System for societal, health, safety, and applications

Text Books:

1. Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, **"Arduino Programming From Beginning to Advanced"**, ISBN : 978-1970054200, (2019).
2. C. Ravichandran, M. Arulalan, **"Microcontroller-based system design"**, *Suchitra Publication*, (1st Edition), (2017).

Reference Books:

1. Myke Predko, **"Programming and customizing the microcontroller"**, *Tata McGraw Hill*, (2nd Edition), (2014).
2. Kenneth Ayala ``**The MICROCONTROLLER-Architecture, Programming and Applications",** *West Publishing Company,* (3rd Edition), (2014).

Online Resources:

1. NPTEL course, **"Microcontrollers and Applications",** https://nptel.ac.in/courses/117/104/117104072/
2. NPTEL course, **"Embedded System",** https://nptel.ac.in/courses/108/105/108105057/

23PEEC501A DBMS

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1 To explain the concepts and applications of database management.
2 To discuss different models and normalization used for database design.
3 To use query languages in databases.
4 To understand NoSQL Databases to handle unstructured data
5 To understand big data and the Hadoop ecosystem

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

CO1 Explain the concepts of DBMS and Big Data
CO2 Apply Structured Query Language on a relational database to retrieve data
CO3 Apply the knowledge of NoSQL databases to handle unstructured data
CO4 Apply the transaction management algorithms for the given tasks

Unit I: Introduction to DBMS
Database Concepts, Database System Architecture, Data Models, entity, attributes, relationships, constraints, keys, E-R Model, EER Model. Relational Model, Attributes and Domains, Referential Integrities. Relational Algebra: Basic Operations. Database Design, Functional Dependency, Purpose of Normalization, Data Redundancy, Anomalies. Normal forms Introduction to SQL, SQL Data Types, DDL, DML, and DCL queries, Views, Indexes, Null handling, Nested Queries. PLSQL, Query optimization. Introduction to NoSQL databases, special-purpose databases- Temporal, Spatial, In-memory, Multimedia databases, vector databases, etc.

Unit II: Database Transaction
Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability, Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules.

Unit III: Concurrency Control and Advanced Database Architectures
Concurrency Control, Locking Methods, Deadlocks, Protocols, Recovery Methods, Database Architectures, Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Indexing and hashing, Parallel Databases, Distributed Databases.

Unit IV: NoSQL and semi-structured Data Management
Structured and unstructured data, NoSQL- Comparative study of SQL and NoSQL databases. BASE Properties, Types of NoSQL databases- Key-value store, Document Store, Column store, and Graph-based, Create, Retrieve, Update, and Delete (CRUD) Operations.

Unit V: Big Data Ecosystem

Big data overview, characteristics of Big Data, applications of Big Data, Challenges enabling real-time big data processing, Hadoop ecosystem, MapReduce Working, the Mapper and Reducer, drivers of Big Data, Emerging Big Data Ecosystem, Data Analytics Life cycle. Data lakes and data warehouses, Ethics in DBMS.

Text Books:

1. Silberschatz A., Korth H., Sudarshan S, Database System Concepts, *McGraw-Hill Publication*, ISBN- 0-07-120413-X, Sixth Edition, (2011)
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, *Pearson Publication*, ISBN-13: 978-0-136-08620-8, 6th Edition, (2011).
3. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", *Packt Publishing*, (2013)

Reference Books:

1. Reema Thareja, Data warehousing, *Oxford University Press*, ISBN 0195699610, 1st Edition, (2009)
2. Raghu Ramakrishnan and Johannes Gehrke, 'Database Management Systems', *McGraw-Hill*, (3rd Edition), (2003)
3. Shashak Tiwari, " Professional NoSQL", *Wiley Publication*, 1st Edition, (2011)

Online Resources:

1. NPTEL "Database management systems" https://onlinecourses.nptel.ac.in/noc22_cs91/
2. NPTEL "Introduction to Database Systems" https://onlinecourses.nptel.ac.in/noc25_cs40/

23PEEC501B MOBILE COMMUNICATION

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. To explain the fundamentals of cellular system design and the techniques used to maximize the capacity of cellular networks
2. To describe the basics of multi-path fading and various parameters used to characterize small-scale fading
3. To explain various multiple access techniques
4. To explore the architecture and call processing of the GSM and CDMA systems

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain the fundamental concepts of cellular networks
CO2 Analyze signal propagation issues and their effect on wireless networks
CO3 Determine the capacity of different multiple access techniques
CO4 Describe the architecture, operation, and call processing of the GSM system
CO5 Analyze design parameters for the CDMA system

Unit I: Cellular Fundamentals

Introduction to wireless Communication Systems, Evolution in cellular standards, Cellular concepts, Frequency reuse, Channel assignment, Handoff, Interference and System capacity, Trunking and Grade of service, Improving coverage and capacity.

Unit II: Mobile Radio Propagation

Propagation mechanism, Free space path loss, Fading and Multipath, Small-scale multipath propagation, Impulse response model of multipath channel, Parameters of mobile multipath channels, Types of small-scale fading, Equalization techniques.

Unit III: Coding and Multiple Access Techniques for Wireless Communications

Selection of Speech Coders for Mobile Communication, Linear Predictive Coders, Vocoders, GSM Codec, Multiple Access Techniques, Orthogonal Frequency Division Multiplexing (OFDM), OFDM applications.

Unit IV: Global System for Mobile Communications

Evolution of mobile standards, system overview, the air interface, logical and physical channels, synchronization, GMSK modulation, call establishment, handover.

Unit V: Code Division Multiple Access (08)

Basics of spread spectrum, Orthogonal codes, Physical and logical channels of IS-95, Handover mechanism, Factors affecting the performance of CDMA system, Comparison of WCDMA and CDMA 2000, Overview of LTE Standard, Architecture and Frame structure of LTE, Introduction to 5G standard, Comparison between 4G and 5G.

Text Books:

1. Theodore S Rappaport**, "Wireless Communications Principles and Practice",** *Pearson Education,* (2nd Edition), (2010).
2. Andrea Goldsmith**, "Wireless Communications",** *Cambridge University Press***,** (1st Edition), (2005)**.**
3. William C.Y. Lee, **"Mobile Communications Engineering: Theory and applications"**, *McGraw-Hill Education*, (2nd Edition), (2017).

Reference Books:

1. Vijay K. Garg, Joseph E. Wilkes, **"Principles and Applications of GSM"***, Pearson Education,* (6th Edition), (2009).
2. *Vijay K. Garg,* **"IS-95 CDMA and CDMA 2000 Cellular/PCS Systems Implementation"**, *Pearson Education,* (1st Edition), (2000).
3. R. Blake, "**Wireless Communication Technology",** *Thomson Delmar,* (1st Edition)*,* (2015).

Online Resources:

1. NPTEL Course on **"Introduction to wireless and cellular communication"** https://onlinecourses.nptel.ac.in/noc20_ee61/

23PEEC501C INTERNET OF THINGS

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. To explore various components of the Internet of Things, such as Sensors, internetworking, and cyberspace
2. To design Internet of Things circuits and solutions

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain Internet of Things (IoT) architecture, protocols, models, and devices used to develop IoT systems
CO2 Identify appropriate protocols, models, and devices to develop an IoT system
CO3 Analyze IoT and M2M, IoT physical devices, networking, and protocol techniques
CO4 Design an IoT system for the given application

Unit I: Introduction to the Internet of Things

Definition of Internet of Things (IoT), fundamentals, Internet of Things (IoT) Architecture and protocols, Characteristics, Design Considerations of IoT systems, Challenges in IoT, Machine-to-Machine. Enabling Technologies, Edge AI.

Unit II: IoT Physical Devices and Cloud Services

Need of IoT tools, sensors and actuators, hardware, software, Operating Systems, IoT Platforms, Implementation of IoT with NodeMCU and Raspberry Pi, Cloud Computing, Fog Computing, Cloud Models and Platforms**,** AWS IoT, Azure IoT Hub, Google Cloud IoT, AI Cloud platforms- AWS SageMaker, Azure Machine Learning, Google AI Platform.

Unit III IoT Communication and Networking

RFID technology, Wireless Sensor Networks, IoT networking layers, Software Define Networks, IPv6 Protocol Overview, comparison of IPv4 and IPv6, IPV6 tunneling, IPsec in IPv6, Quality of Service in IPv6, Privacy and Security Issues in IoT.

Unit IV: IoT Accessing Technologies

Physical and MAC layers require low latency for high bandwidth in large data transfers. Standards include IEEE 802.15.4, IEEE 802.15.4g, IEEE 802.15.4e, IEEE 1901.2a, Zigbee, LoRaWAN, and MQTT protocol.

Unit V: Applications of the Internet of Things

Application of IOT with AI potentially integrated to enhance its functionality in areas: - Home automation, Biomedical, Surveillance, Smart Energy meters, Industry 4.0, Industrial IoT.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** *VPT*, (1st Edition), (2014).
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence,** *Academic Press***,** (1st Edition), (2014).

Reference Books:

1. Honbo Zhou, **"The Internet of Things in the Cloud: A Middleware Perspective",** *CRC Press*, (1st Edition), (2012)
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), **"Architecting the Internet of Things",** *Springer*, (1st Edition), (2011)
3. Olivier Hersent, David Boswarthick, Omar Elloumi, **"The Internet of Things – Key Applications and Protocols",** (1st Edition), *Wiley*, (2012)

Online Resources:

1. NPTEL Course, "**Introduction to IOT"** https://nptel.ac.in/courses/106/105/106105166/

23PEEC501D INTRODUCTION TO HYDRAULIC SYSTEMS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: Physics, Engineering Mathematics, Fluid Mechanics

Course Objectives:

1. Provide opportunity for students to gain appreciation and understanding of a typical intelligent hydraulic system comprised of electro-hydraulic components – this is the confluence of mechanical, hydraulics and electrical/electronic disciplines
2. Prepare students for an interdisciplinary approach and use the latest tools to solve problems
3. Provide comprehensive knowledge of different electro-hydraulic components, circuits, applications and trends
4. Prepare students to draw intelligence out of a typical EH circuit for diagnosis and prediction
5. Encourage self-learning

Course Outcomes:

After completion of the course, students will be able to

CO1	Explain fluid power fundamentals, hydraulic fluid properties, and the merits/demerits of hydraulic systems
CO2	Analyze the working principles and performance characteristics of hydraulic actuators and motors
CO3	Describe the construction, operation, and applications of hydraulic control valves, including proportional and servo valves
CO4	Evaluate the design, selection, and operation of hydraulic pumps, pipes, and fittings based on system requirements Design a simple hydraulic system using accumulators, filters, and coolers while demonstrating the integration of key components

Unit I: Introduction to Fluid Power

Evolution of fluid power systems, components of fluid power, introduction to work and power in hydraulics. Hydraulic fluids: purpose of the fluid, compressible and incompressible fluids, Fluid properties, SAE grades and ISO viscosity numbers, selection of fluid, sources of fluids and additives, Analogies with electrical components, Merits and Demerits of fluid power systems.

Unit II: Actuators and Motors

Introduction to Hydraulic Actuators, Linear actuators, Rotary actuators, Performance characteristics of hydraulic actuators.

Unit III: Hydraulic Valves

Introduction, Construction and application of control valves, proportional valves, and servo valves

Unit IV: Hydraulic Pumps and Fittings

Introduction, construction, operation, and application of hydraulic pumps Fluid conductors, material considerations, installation recommendations, compatibility of hydraulic fluids with hose material, design parameters (cover, tube & reinforcement) and manufacturing processes, governing standards (performance & reliability test for hoses). Determining pipe size requirements, velocity in pipes

Unit V: System accessories and design of simple hydraulic systems

Introduction to hydraulic accessories such as hydraulic accumulators, hydraulic reservoirs, Filters and Coolers, Performance analysis of hydraulic accumulators and hydraulic reservoirs Build a simple hydraulic system to protect and control the system. Demonstrate and use valves, actuators, pumps and motors in simple hydraulic systems.

Text Books:

1. Peter Rohner, "Industrial Hydraulic Control", 4th Edition
2. Andrew Parr, "Hydraulics and Pneumatics",
3. Peter Chappel, "Principles of Hydraulic Systems Design"

23MmEC501 BIOMEDICAL SIGNAL ACQUISITION AND DATA ANALYSIS

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1 To explain and analyse important organ systems in the human body
2 To introduce different Biomedical Signal Acquisition Systems and explore signal conditioning and processing systems for real-life biomedical signals
3 To introduce AI/ML techniques used in Biomedical Applications

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain biomedical signal acquisition and processing
CO2 Apply pre-processing techniques to enhance, denoise, and remove artefacts from acquired biomedical signals
CO3 Analyse ECG, EEG, and biomedical images using signal processing techniques
CO4 Analyse biomedical signals using machine learning techniques

Unit I: Organ Systems and Biomedical Electronics Systems

Introduction to Biomedical Electronics Systems and its need, human Cell and Nerve cell, Action Potential, Resting Potential, Cardiovascular System, Nervous System. Overview of Biomedical Signals: ECG, EEG, EMG, EOG, X-ray, and MRI images.

Unit II: Biomedical Signal Acquisition and Pre-processing

Sensors and Transducers for Biomedical Signal Acquisition, Recording Electrodes, Instrumentation Amplifier, Isolation amplifier, Filters for motion Artefact and noise removal. Pre-processing for biomedical image signals, noise removal using smoothing filters, image enhancement techniques, image negative, Log transformation, Noise models, image restoration and inverse filter.

Unit III: Biomedical Signal Processing Techniques

Time domain and frequency domain filtering, Event detection using derivative and Pan-Tompkins Algorithm, Processing of non-stationary signals (biomedical signals), Short-Time Fourier Transform, Wavelet transform, Introduction to Multi-resolution Analysis and its applications for ECG, EEG and image signals.

Unit IV: Data Analysis for Biomedical Signals

Importance of Data Analysis in Biomedical Research and applications, Machine Learning approaches for Signal Classification and Interpretation, KNN classifier, K-means clustering, Time-series analysis (ECG and EEG signals).

Text Books:

1. R. Rangayyan, "Biomedical Signal Analysis", Wiley India Pvt. Limited, (1st Edition), (2002).
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall India, (4th Edition), (2000).
3. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson Education, (2nd Edition), (2012).

Reference Books:

1. S. Sridhar, M. Vijayalaxmi, "Machine Learning," Oxford University Press, (1st Edition), (2021)
2. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, (2nd Edition), (2003).

Online Resources:

1. NPTEL Course "Biomedical Signal Processing" https://nptel.ac.in/courses/108/105/108105101

23PCEC501L VLSI DESIGN LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives:

1. To explore HDL-based design approach
2. To simulate, synthesize, and prototype a design using PLD
3. To elaborate CMOS logic-based design approach
4. To prepare a layout using a suitable CMOS process
5. To verify the DRC and simulate the layout for different performance parameters

Course Outcomes:

After completion of the course, students will be able to

CO1 Design digital circuits using Verilog HDL
CO2 Implement digital circuits using a suitable PLD
CO3 Design CMOS layout for the given digital logic
CO4 Develop digital systems addressing societal and security applications

List of Experiments:

1. Model a Combinational circuit using Verilog HDL and implement it using PLD
2. Model a Sequential circuit using Verilog HDL and implement it using PLD
3. Model SRAM / FIFO using Verilog HDL and implement it using PLD
4. Write a Verilog Code for LCD and interface it with PLD
5. Design a layout for an Inverter using selected CMOS technology
6. Design a layout for Universal logic gates using selected CMOS technology
7. Design a layout for a Multiplexer using selected CMOS technology
8. Design a layout for a Boolean expression using selected CMOS technology.
9. Open-ended assignment such as
   1. Design of a Home security system
   2. Design of wearable health monitoring system

23PCEC504L MICROCONTROLLER AND APPLICATIONS LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objective

1. To develop hardware interfacing skills
2. To develop software skills in the embedded domain
3. To develop the skill of designing an embedded system using sensors
4. To explore students to development tools required for embedded system

Course Outcome

After completion of the course, students will be able to

CO1 Demonstrate software development tools for Embedded Systems
CO2 Implement software solutions using microcontroller on-chip peripheral for specific control tasks
CO3 Implement software programs for externally interfaced peripheral devices.
CO4 Design a microcontroller-based system for real-life applications.

List of Experiments:

1. Demonstrate the development tools of an embedded system
2. Interfacing LEDs to GPIOs and generating different patterns
3. Implement a program to transmit and receive data serially
4. Interface LCD to display a message
5. Interface Stepper motor and implement a program to control the stepper motor.
6. Implement the program to generate different waveforms using the DAC.
7. Implement a program to control a DC servo motor using PWM
8. Interface LM 35 sensor to internal ADC and display the temperature on LCD
9. Open-ended assignment

23PEEC501LA DBMS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives:

1. To introduce the fundamental concepts of database management.
2. Use of database management.
3. Implement SQL database system
4. Implement NOSQL database system

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply the knowledge of Structured Query Language (SQL) clauses to query the relational database
CO2 Design database schema for the given applications
CO3 Develop a database application with a suitable front end
CO4 Implement SQL and NoSQL databases

List of Experiments:

1. Design and Execute SQL Data Definition Language (DDL) statements to create tables and insert data into the tables.
2. Design and Execute SQL queries for given database applications using SQL Data Manipulation Language (DML) statements: Insert, Select, Update and Delete.
3. Design and execute SQL queries forgiven database application using SQL DML statements: all types of Joins, Sub-Query and View.
4. Create a database using MongoDB and implement Inserting, updating, removing and saving documents.
5. Execute queries on the given MongoDB database and demonstrate the querying techniques namely, find and findOne, Create and drop different types of indexes.
6. Implement Map reduce using MongoDB.
7. Implement XML/JSON database
8. Open-ended-Assignment: Database Application Development

23PEEC501LB MOBILE COMMUNICATION LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE:25 Marks
ESE: 25 Marks
Credits: 1

Course Objective

1. To understand Mobile communication modules
2. To explore various mobile communication protocols
3. To describe the cellular network, error rate, and losses in communication
4. To implement mobile communication modules

Course Outcome

After completion of the course, students will be able to

CO1 Analyze the factors affecting the performance of a cellular network
CO2 Analyze the impact of multipath fading on the bit error rate performance
CO3 Describe the design considerations of the indoor and outdoor communication systems
CO4 Explain the generations of cellular standards
CO5 Interpret the performance of GSM and CDMA

List of Experiments:

1. To study the impact of cluster size on the capacity of a cellular network.
2. To study the impact of sectorization on the S/I ratio.
3. Implementation of free space path loss model.
4. Analyse the performance affecting the indoor and outdoor communication systems.
5. Error rate performance analysis of a fading channel
6. Study direct spread spectrum using CDMA
7. BER performance analysis of GMSK modulation techniques

23PEEC501LC INTERNET OF THINGS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE:25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives

1. To learn the use of sensors and actuators in IOT
2. To learn IOT devices and protocols
3. To build an IOT application

Course Outcome

After completion of the course, students will be able to

CO1 Select sensors and actuators in an IoT application
CO2 Interface sensors and actuators with an IoT development module
CO3 Develop a program to monitor and control using a web server
CO4 Develop an IOT system for real world application

List of Experiments:

1. Write a program to measure sensor data and display it on a serial monitor.
2. Write a program to measure sensor data and control the Actuators for a given application.
3. Implement an IoT application using the MQTT protocol
4. Implement an IoT application using the LORA module
5. Implement a standalone web server using ESP32
6. Develop an IOT system using an IoT development platform and ESP32
7. Develop an IOT system using an AWS cloud and a Raspberry Pi.
8. Open-ended Assignment to develop an IOT system that will be helpful to solve issues related to society, health, and the environment.

23PEEC501LD INTRODUCTION TO HYDRAULICS SYSTEMS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE:25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives

1. To demonstrate the construction, operation, and performance analysis of hydraulic pumps and valves through hands-on experimentation.
2. To develop skills in assembling and testing basic hydraulic circuits (e.g., double-acting cylinders, hydraulic motors) and pneumatic circuits
3. To analyze and implement speed control, metering methods (meter-in/meter-out), and directional control valve circuits for system optimization.
4. To design and validate advanced hydraulic circuits (counter-balancing, regenerative, sequencing) for industrial applications.
5. To synthesize automated hydraulic systems using solenoid valves, limit switches, and programmable controls (e.g., auto-reversing circuits

Course Outcome

After completion of the course, students will be able to

CO1 Assemble and test basic hydraulic circuits (double-acting cylinder, hydraulic motor) and pneumatic circuits (single/double-acting cylinders) to demonstrate understanding of fluid power principles.

CO2 Troubleshoot and optimize hydraulic systems by implementing speed control circuits and metering methods (meter-in/meter-out

CO3 Design and validate advanced hydraulic circuits (counter-balancing, regenerative, sequencing) to solve industrial automation challenges

CO4 Operate and integrate directional control valves, solenoid valves, and limit switches to create multi-actuation systems

CO5 Synthesize an automated hydraulic system using programmable controls (e.g., cam-operated valves, solenoid

List of Experiments:

1. Study of Construction and working Hydraulic pumps
2. Study of Hydraulic valves.
3. Study of solenoid valves, limit switches. Pressure, flow control valve
4. Basic hydraulic circuit for the working of double acting cylinder and a hydraulic motor.
5. Basic pneumatic circuit for the working of single and double acting cylinder.
6. Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in & meter-out circuit)

7. Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.
8. Hydraulic Counter-balancing circuit.
9. Hydraulic Regenerative circuit.
10. Hydraulic Sequencing circuit.
11. Design circuit with cam operated pilot valves operating a pilot operated 4way direction control Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.

Books:

1. "Hydraulics and Pneumatics: A Technician's and Engineer's Guide" By Andrew Parr
2. "Introduction to Fluid Power" By James L. Johnson
3. "Lab Manual for Hydraulics and Pneumatics" By S.R. Majumdar

23MmEC501L BIOMEDICAL SIGNAL ACQUISITION AND DATA ANALYSIS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives:

1. To understand the signal acquisition of some of the biomedical signals
2. To explore and select appropriate signal conditioning techniques
3. To study different ML techniques for analysis and classification

Course Outcomes:

After completion of the course, students will be able to

CO1 Measure biomedical signal using biomedical instruments.
CO2 Analyse the biomedical signal measured using biomedical instruments.
CO3 Apply image enhancement and restoration techniques on biomedical images
CO4 Select an appropriate ML technique for the analysis and classification of biomedical signals

List of Experiments:

1. ECG signal acquisition and time voltage analysis.
2. Heart rate measurement and HRV analysis.
3. Pulse transit time measurement.
4. EEG signal acquisition and frequency domain analysis.
5. Biomedical image enhancement using Histogram equalization and Log transformation.
6. Noise removal from biomedical images using filtering techniques.
7. Segmentation of biomedical images using thresholding and pseudo colouring.
8. Biomedical mage restoration using Wiener filtering.
9. Analyse and classify biomedical signals using ML techniques.