R23- MINOR COURSE SYLLABUS – ECE

23ECM1 – Electronics Devices and Basic Circuits

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

COURSE OUTCOMES:

CO1: Recall the fundamentals of semiconductor physics necessary for electronic devices and circuits (**Remember-L1**)

CO2: Illustrate the structure and operation of Diodes, Bipolar Junction Transistors, Field Effect Transistors and biasing of BJT & FET using fundamental circuits. (**Understand-L2**)

CO3: Apply the knowledge of Diodes, Transistors and Filters for designing the Rectifiers, Regulators and Amplifier circuits using basic components. (**Apply-L3**)

CO4: Analyze the characteristics of Diodes, Bipolar Junction Transistors, Field Effect Transistors and their equivalent models using V-I Characteristics. (**Analyze-L4**)

UNIT I:

Review of Semiconductor Physics: Mobility and Conductivity, Intrinsic and extrinsic semiconductors**,** Hall Effect

Junction Diode Characteristics : Energy band diagram of PN junction Diode, Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in p-n junction Diode, Qualitative explanation of Diode equation (Derivation not required) , V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance

UNIT II:

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, Varactor Diode, LED, Photodiode, Tunnel Diode and its characteristics with the help of energy band diagram, UJT characteristics and its application, PNPN Diode, SCR, Construction, operation and V-I characteristics.

Diode Circuits: Clipping (limiting) circuits, Peak Detector, Clamping circuits, Comparators, Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, Inductor filter, Capacitor filter

UNIT III:

Transistor Characteristics: Junction transistor, transistor current components, transistor equation in CB configuration, transistor as an amplifier, characteristics of transistor in Common Base and Common Emitter configurations, punch through/ reach through, typical transistor junction voltage values.

Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE}, Ic, and β, Stability factors, (S,S$^{'}$,S$^{''}$), Bias compensation, Thermal runaway, Thermal stability.

UNIT IV:

Small Signal Low Frequency Transistor Amplifier Models

BJT: Two port network, Transistor hybrid model, determination of h-parameters, Millers theorem and Dual of Millers theorem, Analysis of CB, CE and CC amplifiers using exact analysis, Comparison of transistor amplifiers.

UNIT V:

FET: FET types, JFET operation and characteristics (qualitative explanation only), small signal model of JFET.

MOSFET: MOSFET Structure, Operation of MOSFET, MOSFET as a variable resistor, derivation of V-I characteristics of MOSFET, Comparison of Bipolar and MOS devices.

CMOS amplifiers: General Considerations, Common Source Stage, Common Gate Stage, Source Follower, comparison of FET amplifiers.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. C. Halkias, Mc-Graw Hill Education.
2. Integrated Electronics-J. Millman, C. Halkias, Mc-Graw Hill Education.
3. Fundamentals of Microelectronics-Behzad Razavi, Wiley, 3rd edition, 2021.

References:

1. Electronics devices & circuit theory- Robert L.Boylestad and LouiNashelsky, Pearson, 11th Edition, 2015.
2. Electronic Devices and Circuits - David A. Bell, Oxford University Press, 5th edition, 2008.
3. Electronic Devices and Circuits- S. Salivahanan, N. Suresh Kumar, Mc-Graw Hill, 5th edition, 2022.

23ECM2 – Analog & Digital Electronics

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

Pre-requisites: Engineering Physics

Course Educational Objective: This course focuses on operation and characteristics of Diodes, Transistors, &its applications and concepts of number system, logic gates, combinational logic circuits, sequential logic circuits, & its applications.

Course Outcomes: At the end of the course, the student will be able to
CO1: **Describe** the operation and characteristics of Diodes and transistors. **(Understand-L2)**
CO2: **Apply** the knowledge of characteristics for deciding the best diode and transistor for given applications. **(Apply-L3)**
CO3: **Understand** the concepts of number systems, Boolean algebra, combinational and sequential logic circuits. **(Understand-L2)**
CO4: **Solve** the given problems using combinational, sequential logic circuits and ASMs. **(Apply-L3)**

UNIT – I
PN Junction Diode: Operation of PN junction Diode, Zener Diode, LED, Photo diode, Solar cell and its Volt- Ampere Characteristics. Applications: Full wave rectifier, Clipper, Clamper.

UNIT – II
Transistor: BJT Operation and characteristics, MOSFET Operation and characteristics, Applications of transistor as an Amplifier, Analog to Digital and Digital to Analog Converters.

UNIT – III
Number Systems and Boolean expressions: Binary Number systems, Hexadecimal Number systems, 1's and 2's complement of binary numbers, Binary codes –BCD, Error detecting and correcting codes – Hamming code. Minimization of Boolean expressions, logic gates, realization of Boolean functions using logic gates

UNIT – IV
Combinational Logic Circuits: Design procedure, Adders and Subtractors, BCD adder, Magnitude Comparator, Decoder, Encoder, Multiplexer, Demultiplexer, and Applications.

UNIT – V
Sequential Logic Circuits: Flip flops-SR, JK, T, D – Characteristic and excitation tables, Counters- Synchronous, Implementation of 4-bit Counters. Introduction to Mealy and Moore machines, Algorithmic State Machines: System design procedure and Memories.

TEXT BOOKS
1. Jacob Millman, Christos C Halkias, Electronic Devices and Circuits, Fourth reprint, Tata McGraw Hill, Publishers, New Delhi, 2011.
2. Morris Mano, "Digital Design", PHI Publishers, 4th Edition.

REFERENCE
1. Donald A. Neamen, Electronic Circuit Analysis and Design, Second Edition, Tata McGraw Hill Publishers, 2014.
2. Charles H. Roth, "Fundamentals of Logic Design", Cengage learning Publishers.

23ECM3 – Fundamentals of Communications

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

Pre-requisites: Concept of signals and modulation theory.

Course Educational Objective: This course provides the knowledge on fundamental properties of systems, radio transmitters, receivers, and noise present in the communication channel and transmission lines and antennas used in communication systems.

Course Outcomes (COs): At the end of the course, students will be able to

CO1	**Summarize** the concepts of noise and the properties of communication systems **(Understand-L2).**
CO2	**Describe** the concepts of communication system, transmission lines, antennas, and response of linear systems **(Understand-L2).**
CO3	**Apply** the knowledge of systems, transmission and reception concepts for communication systems in the presence of noise. **(Apply-L3).**
CO4	**Interpret** the behavior of linear systems and performance of RF transmitters, receivers, transmission lines, and antennas. **(Understand-L2).**

UNIT-I:
Introduction to Systems: Definition, Classification, Properties of Systems - Linear and Non-Linear, Time Invariant and Variant, Causal and Non-Causal, Stable and Unstable; Signal and System Bandwidth.

UNIT-II:
Response of Linear Systems: Transfer Function, Impulse Response, Distortion less Transmission through a system, transmission of a signal through LTI system, elements of a communication system and its description.

UNIT-III:
Noise in Communication Systems: Concepts, external noise, internal noise, White noise, Band limited white noise, Colored noise, noise calculations, noise figure, noise temperature, noise equivalent bandwidth, Narrow band noise and its mathematical representation.

UNIT-IV:
Radio Transmitters: AM transmitter, FM transmitter- Direct method of FM transmission, indirect method of FM transmission.
Radio Receivers: Types of radio receivers-Tuned Radio frequency receiver and its limitations, super heterodyne receiver.

UNIT-V:
Transmission lines: Fundamentals, characteristic impedance, losses in transmission lines, standing waves, Quarter & half wavelength lines and reactance properties.
Antennas: Basics, Directional High Frequency Antennas: Dipole Arrays, Folded dipole and applications, UHF and Microwave Antennas: Antennas with parabolic reflectors, Horn antennas, Lens antennas. (Qualitative Analysis Only)

TEXT BOOKS:
1. Simon Haykin, Communication Systems, Second Edition, John Wiley & Sons Publications, Singapore, 1983.
2. Kennedy, Davis, Electronic Communication Systems, 4th edition, Tata McGraw-Hill Publications, 2009

REFERENCE BOOKS:

1. Herbert Taub, Donald L. Schilling, "Principles of Communication Systems", Second Edition, Tata McGraw-Hill, New Delhi, 1991.
2. B.P.Lathi,"Modern Digital and Analog Communication Systems", Third Edition, Oxford University

23ECM4 – Fundamentals of Embedded Systems

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

COURSE OUTCOMES: At the end of the course, student will be able to

CO1: Understand the basic concepts of an embedded system and able to know an embedded system design approach to perform a specific function.

CO2: The hardware components required for an embedded system and the design approach of an embedded hardware.

CO3: The various embedded firmware design approaches on embedded environment.

CO4: Understand how to integrate hardware and firmware of an embedded system using real time operating system.

UNIT-I

INTRODUCTION: Embedded System-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-II

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-III

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-IV

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co- Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT-V:

EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, Disassembler/De-compiler, Simulators, Emulators and Debugging, Target hardware debugging, Embedded Software development process and tools, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

Text Books:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.

2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

References:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.

2. Embedded Systems-Lyla B. Das-Pearson Publications, 2013.

23ECM5 – Introduction to Internet of Things

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

COURSE OUTCOMES: At the end of the course, student will be able to

CO1: Understand the new computing technologies
CO2: Apply the latest computing technologies like cloud computing technology and Big Data
CO3: Demonstrate the concept of M2M (machine to machine) with necessary protocols
CO4: Create the programs using python scripting language which is used in many IoT devices

Unit I:

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT Communication Models, IoT Communication APIs IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle (Chap 1 and 2)

Unit II:

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANGNETCONF, YANG, SNMP NETOPEER (Chapter 3 and 4)

Unit III:

IOT Platform design Methodology, Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib (Chapter 5 and 6)

Unit IV:

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins., other IOT Devices (Chapter 7)

Unit V:

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API, Amazon web services for IOT, Skynet IOT messaging platform (Chapter 8)

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD),2014, ISBN: 9789350239759

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence, Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.

23ECM6 – Principles of Digital Signal Processing

B. Tech. (Minor)

L	T	P	Cr.
3	0	0	3

COURSE OUTCOMES: At the end of the course, student will be able to

CO1: Understand the concepts of discrete time signals and discrete time systems

CO2: Examine the Fourier Transform, z-Transform and Discrete Fourier Transform of discrete signals.

CO3: Interpret various structures for FIR and IIR filters.

CO4: Design the FIR and IIR filters.

Unit -I:

Introduction: Signals, Systems, and Signal Processing, Classification of Signals, The Concept of Frequency in Continuous Time and Discrete Time Signals

Discrete Time Signals and Systems: Discrete Time Signals, Discrete Time Systems, Analysis of Discrete Time Linear Time Invariant Systems, Discrete Time Systems Described by Difference Equations, Implementation of Discrete Time Systems, Correlation of Discrete Time Signals

Frequency Analysis of Signals: Frequency Analysis of Continuous Time Signals, Frequency Analysis of Discrete Time Signals, Frequency Domain and Time Domain Signal Properties, Properties of the Fourier Transform for Discrete Time Signals.

Unit –II:

Frequency Domain Analysis of LTI Systems: Frequency domain characteristics of LTI systems, Frequency response of LTI systems.

The z-Transform and Its Applications to the Analysis of LTI Systems: The z-Transform, Properties, Rational z Transforms, Inversion of the z-Transform, Analysis of Linear Time Invariant Systems in the z-Domain, The One sided z-Transform.

Unit –III:

The Discrete Fourier Transform: Its Properties and Applications: Frequency Domain Sampling: The Discrete Fourier Transform, Properties of the DFT, Linear Filtering Methods Based on the DFT, Frequency Analysis of Signals Using DFT

Efficient Computation of the DFT: Fast Fourier Transform Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms.

Unit –IV:

Implementation of Discrete Time Systems: Structures for the Realization of Discrete Time Systems. **Structures for FIR Systems**: Direct Form Structure, Cascade Form Structures.

Structures for IIR Systems: Discrete Form Structures, Signal Flow Graphs and Transposed Structures, Cascade Form Structures, Parallel Form Structures.

Unit –V

Design of Analog Filters: Butterworth filters… Low Pass Filter, High Pass filter, Band Pass Filter, Band Reject Filter. **Design of Digital Filters**: General Considerations: Causality and Its Implications, Characteristics of Practical Frequency Selective Filters.

Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear Phase FIR Filters Using Windows, Design of Linear Phase FIR Filters by the Frequency Sampling Method.

Design of IIR Filters From Analog Filters: IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Frequency Transformations: Frequency Transformations in the Analog Domain, Frequency Transformations in the Digital Domain.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, 4th Edition, Pearson Education, 2007.

Reference Books:

1. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, 3rd Edition, Pearson, 2014.
2. Digital Signal Processing-P. Ramesh Babu, 5th Edition, SCITECH Publishers.

23ECM7 – Electronics Devices and Basic Circuits Lab

B. Tech. (Minor)

L	T	P	Cr.
0	0	3	1.5

COURSE OUTCOMES:

CO1: Demonstrate the characteristics of Diode, Zener, BJT, UJT and FET (**Apply-L3**)
CO2: Model the Rectifiers, filters and Amplifiers used in electronic circuits**. (Apply-L3)**
CO3: Analyze the device parameters of Diodes, BJT, UJT and FET for its electrical parameters using VI characteristics. **(Analyze – L4).**
CO4: Adapt effective Communication, presentation and report writing skills. **(Apply- L3)**

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. P-N Junction Diode Characteristics
   Part A: Germanium Diode (Forward bias& Reverse bias)
   Part B: Silicon Diode (Forward Bias & Reverse bias)
2. Zener Diode Characteristics
   Part A: V-I Characteristics
   Part B: Zener Diode as Voltage Regulator
3. Rectifiers (with & without)
   Part A: Half-wave Rectifier
   Part B: Full-wave Rectifier
4. BJT Characteristics (CE Configuration)
5. FET Characteristics (CS Configuration)
6. UJT Characterstics
7. Transistor Biasing (Fixed & Self)
8. CRO Operation and its Measurements
9. BJT-CE Amplifier
10. Emitter Follower-CC Amplifier
11. FET-CS Amplifier

Equipment required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscillo scopes
3. Analog/Digital Function Generators
4. Digital Multi-meters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analogor Digital)
8. Voltmeters (Analogor Digital)
9. Active & Passive Electronic Components

23ECM8 – Analog & Digital Electronics Lab

B. Tech. (Minor)

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: Engineering Physics

COURSE EDUCTIONAL OBJECTIVES: To know the characteristics and applications of Diode, BJT, and logic gates, to design the rectifiers, amplifiers, Combinational and sequential logic circuits and to analyse the functional verification process of analog and digital logic circuits.

COURSE OUTCOMES: At the end of this course student will be able to:
CO1: Study the characteristics of CRO, BJT, Clipper, and Amplifier using electronic devices. **(Understand-L2)**
CO2: Model the Rectifiers, filters and Amplifiers used in electronic circuits**.** (**Apply-L3**)
CO3: **Demonstrate** the functionality of Logic gates, Flip-flops, and Counters **(Understand – L2).**
CO4: **Analyze** the behavior of Combinational and Sequential logic circuits using logic gates and logic circuits **(Analyse – L4)**
CO5: **Adapt** effective Communication, presentation and report writing skills **Apply – L3).**

List of Experiments:

1. Measurement of Voltage, Current and Frequency of a circuit using CRO.
2. Performance analysis of full wave rectifier with and without filter
3. Design of Clipper circuit using diode
4. Study of Input & Output characteristics of BJT in CE configuration
5. Determination of Voltage gain of an amplifier using its frequency response.
6. Verification of truth tables of Logic gates
7. Verification of functional table of 3 to 8 line Decoder/De-multiplexer
8. Design and Verification logic function using 8 to1 multiplexer.
9. Verification of characteristic tables of D FF, JK Flip–Flop
10. Design and verification of three bit ring counter using D Flip–Flops/JK Flip Flop.

23ECM9 – Introduction to Internet of Things Lab

B. Tech. (Minor)

L	T	P	Cr.
0	0	3	1.5

COURSE OUTCOMES: At the end of the course, student will be able to

CO1: Understand the ARM Keil MDK for programming and debugging applications on PSoC

CO2: Demonstrate Python-based IDE for Raspberry Pi based applications

CO3: Develop different IoT applications using PSoC and Raspberry Pi

CO4: Adapt effective communication, presentation and report writing skills

List of Experiments: (Minimum of Twelve Experiments has to be performed)

1. Getting started with Raspberry Pi, Install Raspian on your SD card.
2. Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.
3. Display a word on LCD, Interfacing with Raspberry Pi.
4. Using Raspberry Pi, Display Seven Segment.
5. Servo Motor Controlling with Interfacing using Raspberry Pi.
6. Soil Moisture detecting with soil moisture sensor using Raspberry Pi.
7. Calculate the distance using distance sensor Using Node MCU.
8. Basic LED functionality Using Node MCU
9. Familiarization with ARM keil MDK for programming and debugging an application on the PSoC 4 BLE chip and perform necessary software installation.
10. To interface Push button/Digital sensor (IR/LDR) with ARM keil MDKonPSoC4BLEchipandwriteaprogramtoturnONLED when push button is pressed or at sensor detection.
11. Setup a Bluetooth Low Energy (namely Bluetooth Smart) connection between the PSoC BLE kit and a smart phone and use an app to send and receive data to and from the BLE Pioneer kit.
12. To interface capacitor sensor (touch sensor) with smart phone and write a program to turn RGBLEDON/OFFwhen„1"/"0" is received from smart phone using Bluetooth.
13. Automatic street light control to control the street light (Turn on and off based on the light) using Arduino/Node MCU/Raspberry Pi
14. SmokeDetectionusingMQ-2GasSensor
15. Detecting obstacle with IR Sensor and Arduino/NodeMCU/Raspberry Pi

Equipment required for Laboratories:

- Arduino/NodeMCU/Raspberry Pi+PSoC4 BLE Bluetooth Low Energy Pioneer Kit + Hardware, MQ-2 Gas Sensor, Ultrasonic sound sensor.