Course Curriculum

(Course Structure and Syllabi)

for

Minor Degree Programme

in

Electronics and Communication Engineering

Department of Electronics and Communication Engineering

National Institute of Technology Hamirpur

Hamirpur, Himachal Pradesh – 177005 (India)

2024

Curriculum for Minor Degree Programme

Third Year													
5th Semester							6th Semester						
SN	Code	Subject	L	T	P	C	SN	Code	Subject	L	T	P	C
1	EC-310	Electronic Devices and Circuits	3	0	0	3	1	EC-320	Analog and Digital Communication Systems	3	0	0	3

Fourth Year													
7th Semester							8th Semester						
SN	Code	Subject	L	T	P	C	SN	Code	Subject	L	T	P	C
1	-	-	-	-	-		1	EC-420	Digital Signal Processing	3	0	0	3
2	-	-	-	-	-		2	EC-440	Embedded Systems	3	0	0	3

Course Name: **Electronic Devices and Circuits**

Course Code: **EC-310**

Course Type: **Core (Minor Degree)**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- Understand the fundamental principles of electronic devices and circuits. This includes understanding semiconductor physics, which forms the basis for most modern electronic components.
- Analyze the operation and characteristics of various electronic devices, such as diodes, bipolar junction transistors (BJTs), and field-effect transistors (FETs).
- Troubleshoot basic electronic circuits and identify potential problems.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.	**07L**
UNIT-02	**Basic Electronic Devices:** P-N junction, Zener diode, BJT, LED, photo diode and solar cell; Clipping, clamping, rectifiers, and voltage regulation circuits	**08L**
UNIT-03	**MOSFET:** MOSFET fundamentals, MOSFET principles, MOS capacitor, MOSFET model, MOSFET scaling theory.	**08L**
UNIT-04	**BJT and MOSFET Amplifiers:** Biasing, ac coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers.	**08L**
UNIT-05	**Op-amp Circuits:** Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators.	**08L**

Course Outcomes

Upon successful completion of this course students will be able to :

CO1: Students will be able to explain the fundamental principles of electronic devices, including semiconductor physics and basic circuit analysis techniques.

CO2: Students will be able to differentiate between various electronic devices like diodes, BJTs, and FETs, and describe their characteristics and applications.

CO3: Students will be able to analyze and design basic electronic circuits using diodes, BJTs, and FETs.

CO4: Students will be able to troubleshoot basic electronic circuits and identify potential problems based on their understanding of component behavior.

Books and References

1. OP-AMP and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Publication.
2. Design with Operation Amplifiers and Analog Integrated Circuits, Sergei Franco, TMH.
3. Integrated Electronics: Analog and Digital Circuits & System, Millman & Halkias, TMH.

Course Name: **Analog and Digital Communication Systems**

Course Code: **EC-320**

Course Type: **Core (Minor Degree)**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To introduce the concepts of analog and digital communication systems.
- To equip students with various processing techniques related to analog and digital communication systems such as modulation, demodulation, transmitters and receivers and noise performance.
- Differentiate between different modulation techniques and necessities of the same.

Unit Number	Course Content	Lectures
UNIT-01	**Modulation Techniques:** Various Frequency Bands Used for Communication, Types of Communication and Need of Modulation. Introduction to AM, FM, PM, Frequency Spectrum of AM Waves, Representation of AM, Power Relation in AM Waves, Need and Description of SSB, Suppression of Carrier, Suppression of Unwanted Side-bands, Independent Sideband System, Vestigial Sideband System, Mathematical Representation of FM, Frequency Spectrum of AM Waves, Phase Modulation, Comparison Between Analog and Digital Modulation, Wideband and Narrow Band FM.	**08L**
UNIT-02	**AM Transmitters and Receivers:** Generation of AM, AM Transmitter Block Diagram, AM Modulator circuits, DSB S/C Modulator. AM Receiver: Tuned Radio Frequency (TRF) Receiver. Super Heterodyne Receiver, IF Rejection and IF Amplifiers. Basic Requirements and Generation of FM, FM Modulation Methods: Direct Methods, Variable Capacitor Modulator, Varactor Diode Modulator, Pre-emphasis, Direct FM Modulator, Disadvantages of Direct Method, Armstrong FM Systems. FM Receivers: Limiters, Balanced Slope Detector, Foster-Seeley or Phase Discriminator, De-emphasis.	**10L**
UNIT-03	**FM Transmitters and Receivers:** Basic Requirements and Generation of FM, FM Modulation Methods: Direct Methods, Variable Capacitor Modulator, Varactor Diode Modulator, Pre-emphasis, Direct FM Modulator, Disadvantages of Direct Method, Armstrong FM Systems. FM Receivers: Limiters, Balanced Slope Detector, Foster-Seeley or Phase Discriminator, De-emphasis.	**10L**
UNIT-04	**Analog to Digital Conversion and Digital Modulation Techniques:** Sampling Theorem: Low Pass Signals and Band Pass Signals, Natural Sampling, Flat Top Sampling, Signal Recovery & Holding, Quantization of Signal, Quantization Error, Pulse Code Modulation (PCM), BPSK, BFSK, BASK, QAM modulation. Probability of Error in Digital Modulation Techniques.	**10L**

Course Outcomes

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand the basic building blocks of communication systems, including modulation techniques and transmission media.

CO2: Understand the principles of digital signal processing and its application to communication systems, including techniques for signal filtering, modulation, and demodulation.

CO3: Understand the various communication systems technologies for analog and digital systems.

Books and References

1. Electronic communication Systems by G. Kennedy, McGraw-Hill Education Publisher.

2. Principals of Communication System by Taub & Schilling, McGraw-Hill Education Publisher.

3. Electronic communication Systems by S. Haykin, Wiley India Pvt. Limited Publisher.

Course Name: **Digital Signal Processing**

Course Code: **EC-420**

Course Type: **Core (Minor Degree)**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

Digital Signal processing explains the basics of discrete-time signals and systems. It focuses on the operation on the signals in the time and frequency domain. It covers the different design techniques for FIR and IIR filters and also their realization structures.

Unit Number	Course Content	Lectures
UNIT-01	**DISCRETE-TIME SIGNALS AND SYSTEMS** Basic Elements of a Digital Signal Processing System, Advantages of Digital Signal Processing, Classification of Signals, The Concept of Frequency in Continuous-Time and Discrete-Time Domain, Discrete-Time Signals and Systems, Analysis Of Discrete-Time Linear Shift-Invariant Systems, Linearity, Causality And Stability Criterion, Discrete-Time Systems Described By Difference Equations.	**07L**
UNIT-02	**DISCRETE-TIME FOURIER TRANSFORM** The Fourier Transform Of Discrete-Time Signals (DTFT), Properties Of The DTFT, The Frequency Response Of An LTI Discrete-Time System, The Fourier Series Of Discrete-Time Signals (DTFS).	**08L**
UNIT-03	**DISCRETE FOURIER TRANSFORM:** Frequency Domain Sampling And The DFT, Properties Of The DFT, Linear Filtering Methods Based On The DFT, Efficient Computation Of The DFT: Decimation-In-Time And Decimation-In Frequency Fast Fourier Transform Algorithms.	**08L**
UNIT-04	**Z-TRANSFORM** Introduction To The Z-Transform & The Inverse Z-Transform, Properties of the Z-Transform, Relationship Between The Fourier Transform And The Z-Transform, Rational Z-Transforms & The System Function, Analysis Of Linear Time-Invariant Systems In The Z-Domain.	**08L**
UNIT-05	**DIGITAL FILTER STRUCTURES** Digital Filter Categories, Realization Structures for FIR & IIR Digital Filters, Representation of Numbers: Fixed-Point, Floating Point, Error Resulting from Rounding and Truncation.	**05L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand the discrete-time signals and systems.

CO2: Understand the Fourier transform and Fourier series of discrete-time signals.

CO3: Analysis of the discrete-time signals in the frequency domain using DFT and FFT.

CO4: Understand the Z-Transform and its properties.

CO5: Understand the realization structures for FIR and IIR digital filters.

Books and References

1. Digital Signal Processing: Principles, Algorithms and Applications by John G. Proakis & Dimitris G. Manolakis, Pearson Education.
2. Digital Signal Processing by Sanjit K. Mitra, Tata McGraw Hill Publication.

Course Name: **Embedded Systems**

Course Code: **EC-440**

Course Type: **Core (Minor Degree)**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the microcontrollers, its programming, interrupts, timers and assembly language.
- The concepts of ARM architecture and real time operating system.
- To provide experience to integrate hardware and software for microcontroller application system.
- To impart ability to put together processor, peripherals and memory and build a real time system.

Unit Number	Course Content	Lectures
UNIT-01	Microcontroller: Introduction to Microcontrollers, Evolution, Architectures, Implementations, Background and History of Embedded Systems, Characteristics of ES, Hardware/Software Co-Design, RISC vs CISC, Design challenges and constraints, Real-time systems, Embedded hardware and software architectures, Applications of ASIC and FPGA in ES.	05L
UNIT-02	Programming: Introduction to Embedded System Architecture, The Embedded Systems Model, Embedded Hardware, Assembly Programming, Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation, Serial Port Register, Modes of Operation, Processing Interrupts, Interrupt Service Routines, Look-up Tables.	10L
UNIT-03	Embedded software development: Software development flow, Polling, Interrupt driven, Multi-tasking systems, Architecture of an RTOS, Important features of RTOS, Embedded Systems Programming, Locks and Semaphores, Operating System Timers and Interrupts, Exceptions, Tasks, Task states and scheduling, Task structures, Synchronization, Communication and concurrency, Semaphores, Mutexes, Real-time clock, Memory management. Scheduling algorithms like Round Robin, Rate monotonic, Earliest Deadline First.	08L
UNIT-04	32-Bit Cortex-M Architecture: CPU architecture, Memory model, Registers, Modes, Exceptions, Interrupts, Exception handlers, interrupt controllers, Power modes, Hardware features and optimizations, Advanced bus standards like AMBA, The NVIC on ARM Cortex-M.	07L
UNIT-05	Instruction set of ARM: Syntax, Addressing modes and operands, Memory access instructions, Logical operations, Shift operations, Arithmetic operations, Stack, Functions and control flow, Assembler directives, Thumb and arm instruction differences, Development with Keil and mbed, Applications like IoT and machine learning with cortex-M.	08L

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Write the programs for microcontrollers.

CO2: Understand the role of embedded systems in industry.

CO3: Understand the design concept of embedded systems.

Books and References

1. Mazidi Muhammad Ali, “The 8051 Microcontroller and Embedded Systems”, 2nd Edition, Pearson publications.
2. Joseph Yiu, “The Definitive Guide to ARM Cortex-M3 processors”, 3rd Edition, Newnes publication.
3. Jonathan W. Valvano, “Volume 1, Introduction to ARM Cortex-M Microcontrollers”, 5th Edition, CreateSpace.
4. Jonathan W. Valvano, “Volume 2, Real-Time Interfacing to ARM Cortex-M Microcontrollers”, 4th Edition, CreateSpace.
5. Jonathan W. Valvano, “Volume 3, Real-Time Operating Systems for ARM Cortex-M Microcontrollers”, 2nd Edition, CreateSpace.