COEP Technological University, Pune

(A Unitary Public University of Govt. of Maharashtra)
School of Engineering and Technology

S. Y. B. Tech.

Electronics and Telecommunication Engineering

Detailed Syllabus

Effective from: A.Y. 2026-27

Course Details – Semester III

Analog and Digital Communication

Teaching Scheme	3-0-2-1 (L-T-P-S)
Credits	4
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: CIE 50 | ESE 50

Course Outcomes

Students will be able to:

1. Discuss and compare performance parameters of Analog and Digital systems.
2. Discuss amplitude modulation and demodulation techniques, derive expressions for the same, compute relevant parameters.
3. Discuss angle modulation and demodulation techniques, derive expressions for the same.
4. Discuss sampling theorem and methods for digital conversion. Differentiate between different digital modulation techniques.
5. Evaluate digital signal enhancement techniques towards signal transmission.
6. Analyse and compare various digital modulation schemes.

Unit 1: Introduction to Communication Systems [6 Hrs]

Block diagram of communication systems, Analog and Digital Messages, Signal Transmission through a linear system, Signal distortion over a communication channel, Signal-to-Noise ratio and capacity, Modulation and Detection, Signal Energy and Energy spectral density, Signal power and power density. S: Fourier Transform of periodic and aperiodic signals.

Unit 2: Amplitude Modulation and Demodulation [6 Hrs]

Analog continuous wave modulation, Single and Double sideband Amplitude modulation, Amplitude modulation, Bandwidth-efficient Amplitude demodulation, VSB, Local Carrier synchronization, suppressed sideband modulation. S: Probability density function.

Unit 3: Angle Modulation and Demodulation [6 Hrs]

Nonlinear Modulation, Bandwidth of Angle-modulated Waves, Generating FM waves, Demodulation of FM signals, Nonlinear distortion and interference, Superheterodyne Receivers, FM broadcasting System, power and bandwidth of FM. S: Commercial applications like television transmission.

Unit 4: Sampling and Analog to Digital Conversion [8 Hrs]

Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation, T1 carrier system. S: Shannon's source coding algorithm.

Unit 5: Digital Data Transmission [7 Hrs]

Components of digital communication system, line coding, pulse shaping, Regenerative Repeater, Timing Extraction, Detection Error Probability, M-ary communication, Digital Carrier Systems, Equalization. S: Scrambling and descrambling, eye diagram.

Unit 6: Introduction to Digital Carrier Modulation [6 Hrs]

Modulation techniques for ASK, FSK, PSK, MSK, BPSK, QPSK, GMSK. Demodulation Techniques. S: Error control coding.

Textbooks

[1] Digital and analog communication system by B. P. Lathi and Zhi Ding, Fourth edition, Oxford University Press, 2010.
[2] Digital & Analog Communication Systems by Shanmugam K.S., John Wiley & Sons, New York, Jan 2012.

Reference Books

[1] Introduction To Analog & Digital Communications By Simon Haykin, Second Hand Book, VISIONIAS, Jan 2020.
[2] Advanced Electronic Communications Systems, Wayne Tomasi, Pearson.

Note

[1] To measure CO1, questions may be of the type: define, identify, state, match, list, name, etc.
[2] To measure CO2, questions may be of the type: explain, describe, illustrate, evaluate, give examples, compute, etc.
[3] To measure CO3, questions will be based on applications of core concepts.
[4] To measure CO4, questions may be of the type: true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries, etc.
[5] To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Analog and Digital Communication Lab

Lab Course Outcomes

Students will be able to:

1. Demonstrate modulation and demodulation techniques for AM and FM.
2. Implement digital modulation and demodulation techniques.
3. Analyze the analog and digital communication using MATLAB.

List of Experiments / Assignments

1. AM Modulation and Demodulation
2. FM Modulation using PLL
3. Pulse Amplitude Modulation and Demodulation
4. Pre-emphasis and De-emphasis
5. Analog Multiplexing
6. Sampling and Reconstruction
7. Delta and Adaptive Delta Modulation
8. A and Mu Law Compression and Decompression
9. Line Coding
10. ASK, FSK and PSK Modulation and Demodulation
11. 16 QAM

Software Assignments using MATLAB/ Scilab:

1. AM Modulation
2. FM Modulation
3. Observing Spectrum of Different Waveforms
4. ASK, FSK and PSK Modulation
5. Huffman Coding

Electronics Devices and Circuits	
Teaching Scheme	3-0-2-1 (L-T-P-S)
Credits	4
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: CIE 50 | ESE 50

Course Outcomes

Students will be able to:

1. Understand the physics of BJT and MOS devices, their operation and characteristics, and large signal and small signal model.
2. Analyze bipolar and CMOS sub circuits like single stage amplifier and evaluate voltage gain, input output impedance and its biasing configurations.
3. Analyze Frequency response of circuits and determine pole and zeros through inspection.
4. Apply feedback to stabilize the circuits and evaluate gain and input output impedances.
5. Analyze various types of oscillators and evaluate their criteria for oscillation.
6. Analyze power amplifiers and determine power dissipation and heat sink criteria.

Unit 1: Physics of MOS and BJT Transistors [6 Hrs]

Physics of MOS Transistors: Structure of N and P MOSFET, Energy-Band Diagram, Operation of MOSFET in cutoff, saturation and triode region, I/V characteristics, Concept of Threshold Voltage, Some second order effects: Channel Length Modulation, Back Gate Effect, MOS Device Models – Large Signal model and small signal model, Concept of transconductance gain, Concept of resistance ro, gds, avalanche voltage, gbs, CMOS Technology. Bipolar Junction Transistors: Operation of BJT in Cutoff, saturation and Active mode, I/V characteristics, Large Signal model, small signal model, Concept of transconductance, Early Effect. S: Packages of MOSFETs and BJTs.

Unit 2: Analog Sub-Circuits [6 Hrs]

Bipolar Amplifiers: Operating Point Analysis and Design, Input and Output Impedances, Biasing, DC and Small signal Analysis, Bipolar amplifier Topologies – Common Emitter with and without emitter degeneration. CMOS Amplifiers: MOS Amplifier Topologies, Biasing, Realization of Current Sources, Common Source stage with and without source degeneration, Common Gate stage, Source Follower, Cascaded stages. Cascode current sources and Cascode amplifiers, Concept of Current biasing and current mirrors. S: Bipolar amplifier Topologies – Common Base, Emitter Follower.

Unit 3: Frequency Response [6 Hrs]

Fundamental Concepts, square wave testing, effect of coupling, bypass, junction and stray capacitances, Relationship between Transfer function and Frequency Response, Determination of Pole-Zero through inspection at nodes, Miller's Theorem, Bode's Rules, Concepts of Frequency Response, High frequency Model of Transistor. S: Laplace transform.

Unit 4: Feedback Amplifiers

General feedback structure (Block schematic), Loop gain, Nyquist stability Criterion for positive and negative feedback circuits, properties of Negative feedback – Gain Desensitization, Bandwidth Extension, Modification of I/O impedances, Linearity improvement, Sense and Return Techniques, Feedback Amplifiers – Voltage Voltage Feedback, Voltage Current Feedback, Current Voltage Feedback, Current Current Feedback. S: Poles and Zeros in a system.

Unit 5: Oscillators

Criterion for oscillation, Barkhausen's criteria, Crystal oscillators, RC oscillators, LC Oscillators, Ring Oscillators, Voltage Controlled Oscillators.

Unit 6: Output Stages and Power Amplifiers

Emitter follower as Power Amplifier, Push pull stage, large signal considerations, Class-A, B, AB, C power amplifiers, Power dissipation and Power Efficiency for different types of amplifiers, short circuit protection, Heat Dissipation, heat sink requirement. S: Mechanical structures of heatsinks and their fittings.

Textbooks

[1] Fundamentals of Microelectronics by Behzad Razavi, Second Edition, Wiley.

[2] Microelectronics Circuits by Adel Sedra, Kenneth Smith, Seventh Edition, Oxford University Press.

Reference Books

[1] Solid State Electronic Devices, Ben G Streetman, Sanjay Kumar Banerjee, Sixth Edition, PHI.

[2] Microelectronics Circuit Analysis and Design, Donald A. Neamen, Fourth Edition, McGraw Hill.

[3] Electronic Devices, Thomas L Floyd, 10th edition, Pearson.

Note

[1] To measure CO1, questions may be of the type—define, state, list, identify, sketch and explain, compare device characteristics, and interpret basic curves.

[2] To measure CO2, questions may be of the type—explain circuit operation, analyze amplifiers, derive gain and impedances, evaluate biasing, and solve numerical problems.

[3] To measure CO3, questions will focus on applications such as frequency response analysis, determination of poles and zeros, bandwidth calculation, and Bode plot interpretation.

[4] To measure CO4, questions may include—analysis of feedback circuits, gain and impedance calculations, true/false with justification, and theoretical/numerical problems.

[5] To measure CO5, questions may involve—analysis of oscillators, conditions for oscillation, frequency calculation, and comprehension-based problems.

[6] To measure CO6, questions may be of the type—analysis of power amplifiers, efficiency and power dissipation calculations, and heat sink design problems.

Electronics Devices and Circuits Lab

Lab Course Outcomes

Students will be able to:

1. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
2. Design, Simulate and Analyze small signal parameters and gain of BJT and MOS amplifiers using Spice tools.
3. Design, Simulate and Analyze performance of feedback amplifiers, oscillators and power amplifiers using Spice tools.
4. Simulate frequency response of single stage amplifiers and study effects of coupling and bypass capacitors.

List of Experiments / Assignments

1. DC & Parametric Analysis for NMOS & PMOS. Plot Output Characteristics & Transfer characteristics (Observe gm, rd and µ from characteristics).
2. DC & AC Analysis for Common Source Amplifier – PMOS with Resistive Load, PMOS with Ideal Current Source, NMOS with R load, NMOS with Diode Connected Load, NMOS with Rd and degenerated Rs. Calculate & Observe gm, rout.
3. DC & AC Analysis for Common Gate Configuration – NMOS with Resistive Load, NMOS with MOS Load. Calculate & Observe gm, rout.
4. DC & AC Analysis for Common Drain Configuration – NMOS with Resistive Load, NMOS with MOS Load. Calculate & Observe gm, rout.
5. DC & AC Analysis for Cascode Amplifier – with Resistive Load, Ideal current source load, Cascode connected load with PMOS transistors. Calculate & Observe gm, rout.
6. Basic current mirror circuit.
7. Design a simple CS MOSFET amplifier and determine its frequency response.

8. Design and simulate Voltage Shunt Feedback Amplifiers (compare performance with and without feedback).
9. Design and simulate Current Series Feedback Amplifiers (compare performance with and without feedback).
10. Design and simulate LC and RC oscillators (compare practical and theoretical oscillation frequency).
11. Build and test LC or RC oscillator.
12. Design and simulate Power Amplifiers – Class A, Class AB complementary symmetry (efficiency calculations and comparison).
13. Design a regulated power supply for the given specifications. (All above experiments to be simulated using LTSpice Simulator before implementing on breadboard.)

Digital System Design	
Teaching Scheme	3-0-2-1 (L-T-P-S)
Credits	4
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: CIE 50 | ESE 50

Course Outcomes

Students will be able to:

1. Simplify and implement logic functions using basic and universal gates.
2. Represent and convert numbers in various forms for arithmetic operations.
3. Design and synthesize combinational logic circuits.
4. Design and synthesize sequential logic circuits.
5. Compare TTL and CMOS technology in terms of voltage levels, power dissipation, noise margin.
6. State applications for quantum computing. Design basic circuits using qubit gates.

Unit 1: Introduction to Logic Circuits [8 Hrs (6L+2S)]

Analysis and Synthesis of logic circuits using basic and universal gates, Design examples, Optimized implementation of logic functions, Static and dynamic hazards. S: Boolean algebra, SOP, POS, up to 6 variable K-map.

Unit 2: Number Representation and Arithmetic Circuits [12 Hrs (10L+2S)]

Number representation, Number systems and its arithmetic, unsigned and signed numbers, arithmetic overflow, fixed point and floating point arithmetic, Design of arithmetic Circuits like Full adder, Ripple carry adder, Fast adder, Asymptotic time complexity, design of carry look-ahead adder, weighted and non-weighted Codes, Multiplier (32 by 32) – Shift and Add, Booth's algorithm (Two 32-bit numbers producing 64-bit result), Division – Iterative divider (time complexity), rounding, truncation. S: Binary representation and arithmetic, Iterative multiplier, Wallace tree multiplier.

Unit 3: Combinational Circuit Building Blocks [6 Hrs (4L+2S)]

Multiplexer synthesis using Shannon's expansion, decoder, Priority encoder, Synthesis and analysis of logic functions using Multiplexer and decoder. S: Octal to binary encoder, Design of 4:16 decoder using 3:8 decoder, Basic and Universal gates using MUX.

Unit 4: Synchronous Sequential Design [10 Hrs (8L+2S)]

Basic latch, Gated SR and D latch, Master slave and edge triggered Flip flops (D, JK and T), Shift Registers, Counters, Design of ripple and synchronous counters, Design and implementation of counters using JK FF and D FF, Introduction to FSM and its synthesis. S: MOD counters, Random sequence counter, Vending machine: water bottle dispenser.

Unit 5: Implementation Technology [6 Hrs (4L+2S)]

TTL and CMOS technology, voltage levels, Noise margin, power dissipation, Fan in and Fan out, Source and sink current. S: Different logic families: I2L, ECL, MOS, Interfacing of TTL and CMOS ICs.

Unit 6: Introduction to Quantum Computing [4 Hrs (3L+1S)]

Quantum computing roadmap, quantum mission of India, applications of quantum, quantum basics, building block: single qubit gates, quantum circuits with single qubit gates.

Textbooks

[1] M. Morris Mano, Michael D. Ciletti, Digital Design, Pearson, Fourth edition.

[2] R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, Fourth edition.

Reference Books

[1] Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, McGraw Hill, Third edition.
[2] A. Anand Kumar, Fundamentals of Digital Circuits, PHI, Fourth edition.
[3] Rajiv Kumar, Quantum Computing, Pearson, 2022.

Note

[1] To measure CO1 and CO2, questions may be of the type: identify, simplify, solve, convert, etc.
[2] To measure CO3 and CO4, questions will be of the type: design and analyse.
[3] To measure CO5, questions may be of the type: Define, state, explain, etc.
[4] To measure CO6, questions may be of the type: Define, state, solve, etc.

Digital System Design Lab

Lab Course Outcomes

Students will be able to:

1. Design and implement combinational logic circuits based on given functional specifications.
2. Design and implement sequential logic circuits and qubit circuits based on given functional specifications.

List of Experiments / Assignments

1. Implement logic functions using basic and universal gates.
2. Simplify given logic functions using (a) Boolean algebraic laws, theorems (b) K-maps. Implement using basic and universal gates.
3. Design and implement logic functions using multiplexer IC 74151 and IC 74153.
4. Design and implement logic circuits using decoder IC 74139/74138.
5. Implement binary adder/subtractor, BCD adder using IC 7483 and additional gates.
6. Verification of JK, T, D flip-flops.
7. Design and implement ripple counters using flip-flops and additional gates.
8. Design and implement synchronous counters using flip-flops and additional gates.
9. Design and implement a counter using counter ICs 7490 and 7493.
10. Design and implement a counter using counter IC 74191 (synchronous).
11. Verify bidirectional shift register IC 7495/74194. Design and implement a pulse train generator, ring counter, twisted ring counter using the same.
12. Design a sequence detector circuit using Moore and Mealy model.
13. Verify single and multi-qubit gates using Qiskit.

Microcontrollers and Interfacing (Open Elective – Semester III)

Teaching Scheme	2-0-0-1 (L-T-P-S)
Credits	2
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: None

Course Outcomes

Students will be able to:

1. Comprehend and analyze the architecture of the 8051 microcontroller and compare it with general-purpose microprocessors.
2. Understand the internal memory organization, SFRs, and hardware resources of the 8051 microcontroller.
3. Write and analyze Embedded C programs for the 8051 using timers/counters, serial communication, and interrupts.
4. Interface the 8051 microcontroller with common input/output devices such as LEDs, LCDs, 7-segment displays, and keypads.
5. Design 8051-based systems incorporating ADC, DAC, stepper/DC motors, and sensors within realistic engineering constraints.

Unit I: Fundamentals of Microprocessors and the 8051 Family [6 Hrs]

Microprocessor architecture basics; comparison of 8-, 16- and 32-bit microcontrollers; embedded system concepts and role of microcontrollers; overview and features of the 8051 family and its variants. S: Selection criterion for microcontrollers.

Unit II: 8051 Architecture and Instruction Set [8 Hrs]

8051 internal architecture: CPU, ALU, buses, registers, SFRs, clock/reset, stack, PC, I/O ports, and memory organization. Machine cycles and timing. Addressing modes and overview of instruction set. Embedded C fundamentals: program structure, data types, assemblers/compilers, and Keil IDE. S: Assembly language and embedded C programs.

Unit III: Timers/Counters, Serial Communication and Interrupts [8 Hrs]

Timer/Counter programming (modes, registers, delay and event counting). UART serial communication, baud rate generation, transmit/receive programming. SPI, and I2C. Interrupt system: sources, priority, vectors, and ISR programming with applications. S: Overview of RS-232.

Unit IV: Interfacing and Applications [6 Hrs]

Memory and I/O expansion, control signals, and wait states. Interfacing of GPIO devices, LEDs, LCDs, 7-segment displays, keypads, motors, and sensors. ADC/DAC interfacing. S: Introduction to Bluetooth and Zigbee protocols.

Textbooks

[1] M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, 2007.

[2] K. J. Ayala, The 8051 Microcontroller: Architecture, Programming and Applications, Delmar Cengage Learning, 2004.

[3] R. Kamal, Embedded Systems: Architecture, Programming and Design, McGraw Hill Education, 2009.

Reference Books

[1] Kenneth J. Ayala, The 8051 Microcontroller: Architecture, Programming and Applications, Penram International, 1991.

[2] Raj Kamal, Embedded Systems: Architecture, Programming and Design, Tata McGraw-Hill Education, 2008.

[3] R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085, Penram International Publishing, 1996.
Note
[1] To measure all COs (CO1–CO5), questions may be of the apply, solve, analyse, calculate type.

Course Details – Semester IV

Electromagnetic Waves and Antennas

Teaching Scheme	2-0-0-1 (L-T-P-S)
Credits	2
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50

Course Outcomes

Students will be able to:

1. Analyze the transmission lines and estimate voltage and current at any point on transmission line for various load conditions.

2. Use the Smith Chart as a tool for transmission line calculations and analysis.

3. Determine the solution to real-life plane wave problems for various boundary conditions using concepts of electromagnetic wave propagation.

4. Analyze the field equations for the wave propagation in special cases such as lossless, low loss and lossy dielectrics medium.

5. Visualize TE and TM mode patterns of field distributions in rectangular waveguide.

6. Characterize the radiation of an antenna and antenna array in terms of pattern, directivity, gain, bandwidth and radiation resistance.

Unit 1: Transmission Lines [9 Hrs]

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, standing waves and impedance transformation, Lossless and low loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Unit 2: Uniform Plane Waves [7 Hrs]

Uniform Plane Waves: Maxwell's equations. Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Unit 3: Plane Waves at Media Interface [5 Hrs]

Guided Waves: Waves in Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic (TM) mode, Cut-off frequency, Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach

Unit 4: Guided Waves [7 Hrs]

Antennas: Introduction to Antenna basics and characteristics, Effective aperture, Friis Transmission formula, general concept of dipole antenna, short dipole and loop antenna, Slot antennas, Babinet's principle.

Textbooks

[1] Shevgaonkar, R. K., Electromagnetic Waves, Tata McGraw-Hill Education, 2006.

[2] Balanis, Constantine A., Antenna Theory: Analysis and Design, John Wiley & Sons, 2016.

Reference Books

[1] Nathan Ida, Engineering Electromagnetics, 2nd Edition, Springer.

[2] Edward C. Jordan and Keith G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, 2006.

[3] Ramo, S., Whinnery J. R., and van Duzer T., Fields and Waves in Communication Electronics, 3rd Edition, John Wiley & Sons.

Linear Integrated Circuits

Teaching Scheme	3-0-2-1 (L-T-P-S)
Credits	4
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: CIE 50 | ESE 50

Course Outcomes

Students will be able to:

1. Understand basic configurations and circuits of operational amplifier.
2. Demonstrate the operational amplifier in the form of active filter.
3. Develop the non-linear applications of operational amplifier.
4. Use the operational amplifier as waveform generator.
5. Develop the applications of operational amplifier as ADC and DAC.
6. Design circuits with phase lock loop.

Unit 1: Advanced Circuit Topologies [8 Hrs]

Block diagram of OPAMP, differential signals, differential pair, bipolar differential pair, level shifter, output stage of opamp, Cascade current mirror, Cascade stages, Current Mirrors, Op-Amp parameters, Concept of feedback & their types, Inverting & non-inverting configurations, current to voltage converters, voltage to current converters, summing amplifier, difference amplifier, instrumentation amplifier.

Unit 2: Active Filters [6 Hrs]

Transfer Function, passive filters, Stability, First-order active filters, Standard second-order responses, KRC filters, Biquad Filters, audio filter applications, Sensitivity.

Unit 3: Non-linear Circuits [6 Hrs]

Schmitt trigger, voltage comparators, comparator applications, precision rectifiers, analog switches, peak detectors, sample & hold circuits, integrators & differentiators, and log/antilog amplifiers.

Unit 4: Signal Generators [6 Hrs]

Sine wave generators, multivibrators, triangular wave generators, sawtooth generators, V to F and F to V converters, function generator IC.

Unit 5: D-A and A-D Converters & Regulators [6 Hrs]

Performance specifications, D-A conversion techniques, A-D conversion techniques, and single chip implementation of DAC and ADC. Performance specifications of regulators, linear regulators, and modifications for variable voltage, current boost & protection circuits.

Unit 6: Phase Locked Loops & Multipliers [6 Hrs]

Block diagram of PLL, free running frequency, lock range, capture range, and sample circuits for each block. Applications of PLL: frequency synthesizer, FM demodulator, AM demodulator, FSK demodulator, analog multiplier, and multiplier IC.

Self-Study [8 Hrs]

Biasing of transistor circuits, active filter resonance and bandwidth concepts, and PSPICE simulation of op-amp-based circuits and monolithic timer IC 555-based circuits. Datasheets of DAC and ADC chips and ADCs in microcontrollers. Voltage-controlled oscillator.

Textbooks

[1] Op-Amps and Linear Integrated Circuits, by Ramakant A. Gayakwad, PHI, Fourth edition, May 2015.

[2] Linear Integrated Circuits, by D. Roy Choudhary and Shail B Jain, New Age Int, Fourth Edition, July 2021.

Reference Books

[1] Design with Operational Amplifiers and Analog Integrated Circuits, by Sergio Franco, Tata McGraw Hill, Third Edition, July 2017.

[2] Operational Amplifiers, by G.B. Clayton and Steve Winder, EDN Series for Design Engineers, Second Edition, March 2003.

Note

[1] To assess CO1, questions shall focus on fundamental understanding, such as definitions, identification of components, basic configurations, listing, naming, and conceptual recall related to operational amplifiers.

[2] To assess CO2, questions shall evaluate students' ability to explain, describe, illustrate, and analyze active filter circuits, including solving numerical problems and interpreting filter responses.

[3] To assess CO3, questions shall be application-oriented, requiring students to develop and analyze non-linear circuits such as comparators, rectifiers, and other practical op-amp applications.

[4] To assess CO4, questions may include waveform analysis, theoretical problem-solving, justification-based true/false, and design or interpretation of waveform generator circuits.

[5] To assess CO5, questions shall involve circuit design, analysis, and problem-solving related to ADC and DAC systems, including performance evaluation and implementation aspects.

[6] To assess CO6, questions shall focus on design, analysis, and application of phase-locked loops, including concepts from self-study topics and interpretation of unseen problem scenarios.

Linear Integrated Circuits Lab

Lab Course Outcomes

Students will be able to:

1. Demonstrate the linear and non-linear applications using operational amplifiers.
2. Implement active filters.
3. Analyze different parameters of phase lock loop and waveform generator chips.

List of Experiments / Assignments

1. Op-amp applications I: Integrator, Differentiators.
2. Op-amp applications II: Comparator (LM 339), Schmitt trigger.
3. Design, build, and test a precision rectifier.
4. Design, build, and test a square wave generator using an op-amp.
5. Design, build, and test a Sine wave generator using op-amp.
6. Design, build and test a second order filter using op-amp.
7. Implementation of function generator IC8038.
8. Design, build and test different types DAC & study ADC IC.
9. To study the operation of IC 565 as PLL and measure lock range, capture range & one application.

Microcontrollers and Applications

Teaching Scheme	3-0-2-1 (L-T-P-S)
Credits	4
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: CIE 50 | ESE 50

Course Outcomes

Students will be able to:

1. Explain microcontroller architecture, memory organization, and working principles including Harvard architecture, Von Neumann architecture, and RISC/CISC concepts.
2. Develop programs using assembly language and Embedded C in IDE environments such as Keil uVision for solving basic embedded system problems.
3. Demonstrate addressing modes, instruction sets, and the operation of timers and counters in 8-bit microcontrollers such as 8051.
4. Analyze and design interfacing circuits for peripherals including LED, keypad, ADC, DAC, and motors using microcontrollers.
5. Examine and implement communication protocols such as SPI, I2C, and UART for embedded system applications.
6. Design and develop a complete embedded system integrating sensors, actuators, and communication interfaces for real-world applications such as biomedical monitoring systems.

Unit 1: Introduction to Microcontroller [8 Hrs]

Number systems, microcontrollers vs microprocessors, RISC vs CISC architecture, Von-Neumann vs Harvard architecture, comparison of 8-bit/16-bit/32-bit microcontrollers, stack and stack pointer, memory structure, data memory, program memory, and program execution.

Unit 2: Programming with Microcontroller [8 Hrs]

Assembler directives, editor, linker, loader, debugger, simulator, emulator, instruction set, basic assembly programming, introduction to embedded C, IDE, cross compiler, ISP, and software delay generation.

Unit 3: 8-bit Microcontroller [8 Hrs]

Introduction to 8-bit microcontrollers, addressing modes, instruction set, architecture, pin description, interrupts, operating modes, analog I/O, PWM, digital I/O, and memory mapping (internal and external).

Unit 4: I/O Interfacing [6 Hrs]

I/O programming, interfacing with switches, LEDs, keypads, timers, counters, modes of timers, and PWM programming.

Unit 5: Communication Protocols [6 Hrs]

SPI protocol, SPI memory interfacing, USART/UART communication, interrupt handling, I2C communication, RTC interfacing, and watchdog timer (WDT).

Unit 6: External Peripheral Interfacing [6 Hrs]

ADC interfacing, serial and parallel ADCs, DAC interfacing, stepper motor interfacing, DC motor interfacing, and comparative analysis of different 8-bit microcontrollers.

Textbooks

[1] Mazidi, 8051 Microcontroller and Embedded Systems, Pearson.

[2] Mazidi, PIC Microcontroller and Embedded Systems, Pearson.

[3] Kenneth J. Ayala, 8051 Microcontroller, Cengage.
[4] John H. Davies, MSP430 Microcontroller Basics, Newnes.

Reference Books

[1] Kenneth J. Ayala, 8051 Microcontroller: Architecture, Programming & Applications.
[2] John B. Peatman, Design with PIC Microcontrollers.
[3] MSP430 Technical Reference Manual (TI).
[4] MSP430 Datasheet (Texas Instruments).
[5] Muhammad Ali Mazidi, AVR Microcontroller and Embedded Systems.

Microcontrollers and Applications Lab

Lab Course Outcomes

Students will be able to:

1. Develop programs using assembly language and Embedded C in IDE environments such as Keil uVision IDE for solving basic embedded system problems.

2. Demonstrate the use of addressing modes, instruction sets, and timers/counters in 8-bit microcontrollers like 8051.

3. Analyze and design interfacing circuits for peripherals such as LED, keypad, ADC, DAC, and motors using microcontrollers.

4. Examine and implement communication protocols such as SPI, I2C, and UART for embedded system applications.

5. Design and develop a complete embedded system integrating sensors, actuators, and communication interfaces for real-world applications.

List of Experiments / Assignments

1. Programming 8051 Microcontroller using ASM and C and implementation in flash 8051 Microcontroller.
2. Programming with Arithmetic logic instructions [Assembly and C]: Addition, Subtraction, Multiplication, Division of 2-8 bit numbers.
3. Program using constructs (Sorting an array) [Assembly and C]: Finding maximum value in an array; Sorting data in Ascending and Descending order.
4. Programming using Ports [Assembly and C].
5. Delay generation using Timer [Assembly and C].
6. Programming Interrupts [Assembly and C]: Code Conversion HEX TO ASCII; Square root of a given data.
7. Write an ALP to exchange a block of data of length 'N' stored at RAM address 9000H and 9100H.
8. Write an ALP to count odd and even numbers in a block of 'N' numbers stored at RAM address 1000H.
9. Write an ALP to simulate BCD up counter interfacing.
10. Write an 8051 C program to design a counter for counting pulses of an input signal through P3.4, display each count on the logic controller interface.
11. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
12. Interfacing LED and Interfacing Push button.
13. Interfacing Sensors.
14. Write an 8051 C program to display strings on a 2x16 character LCD Interface [Assembly and C].
15. 8-bit DAC.
16. 8-bit ADC.
17. DC and Stepper motor control using 8051 microcontrollers.
18. Write an 8051 C program to drive a Stepper motor Interface to rotate the motor by N steps clockwise and N steps anticlockwise.
19. Write an assembly language program to display characters on a seven-segment display interface.
20. Write an 8051 C program to scan a 4x4 keypad for key closure and display the pressed code on LCD.
21. Write an 8051 C program to drive an elevator interface (ground floor default, moves to requested floor, services request).
22. Interfacing with I2C and SPI protocol.
23. Project based learning.

Control Systems

Teaching Scheme	2-0-0-1 (L-T-P-S)
Credits	2
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: None

Course Outcomes

Students will be able to:

1. Obtain the transfer function of a physical system using block diagram reduction and Mason's gain formula. Model electrical and mechanical systems mathematically.

2. Analyse the time-domain response of first- and second-order control systems and determine performance parameters including steady-state error.

3. Assess the stability of a linear control system using Routh-Hurwitz criterion. Sketch and interpret root locus plots.

4. Analyse frequency-domain behaviour using Bode and Nyquist plots. Determine gain margin and phase margin.

5. Explain the concept and need for compensation. Describe the characteristics of lead, lag, and lead-lag compensators. Describe P, PI, PD and PID controllers and state applications of control systems in various domains.

Unit 1: Introduction, Transfer Function and Mathematical Modelling [6 Hrs]

Basic Elements of Control System, Open loop and Closed loop systems, Feedback and its effects, Transfer function, Block diagram reduction technique, Signal Flow Graphs and Mason's Gain Formula, Mathematical modelling of electrical and mechanical systems (translational and rotational). S: Electromechanical systems – DC motor and synchro.

Unit 2: Time Domain Analysis [5 Hrs]

Transient response and steady state response, standard test inputs, order and type of system, transient analysis of first and second order systems, time domain specifications of second order system, Steady state error and static error constants. S: Effects of adding poles and zeros on transient response.

Unit 3: Stability Analysis Techniques [6 Hrs]

Characteristic equation of a system, concept of stability, absolute stability, relative stability, Routh-Hurwitz stability criterion. Root locus, concept of dominant poles, effect of addition of pole and zero on root locus. S: Lyapunov stability – concept and direct method.

Unit 4: Frequency Response Plots [5 Hrs]

Frequency response and frequency domain specifications, Bode plot, stability analysis using Bode plot. Polar plot concept. Nyquist stability criterion (concept and encirclement).

Unit 5: Introduction to Compensators and Controllers [4 Hrs]

Need for compensation, Conceptual introduction to lead, lag, and lead-lag compensator, Realization of compensators using electrical RC networks. P, PI, PD and PID controllers, and industrial applications. Applications of control systems in defense, agriculture, automotive, robotics. Use of AI in control systems.

Textbooks

[1] Nise, N. S., Control Systems Engineering, 6th Ed., Wiley, 2017.

[2] Ogata, K., Modern Control Engineering, 5th Ed., Pearson.

[3] Kuo, B. C. & Golnaraghi, F., Automatic Control Systems, 9th Ed., Wiley.

[4] Dorf, R. C. & Bishop, R. H., Modern Control Systems, 13th Ed., Pearson.

Reference Books
[1] Nagrath, I. J. & Gopal, M., Control Systems Engineering, 6th Ed., New Age International. **[2]** Manke, B. S., Linear Control Systems with MATLAB Applications, Khanna Publishers. **[3]** Kumar, A. A., Control Systems, 2nd Ed., PHI Learning.
Note
[1] To measure all COs (CO1–CO5), questions may be of the type apply, solve, analyse, calculate.

Principles of Electronic Communication (Open Elective – Semester IV)

Teaching Scheme	2-0-0-1 (L-T-P-S)
Credits	2
Examination Scheme	Theory: TA 20 | MSE 30 | ESE 50 Laboratory: None

Course Outcomes

Students will be able to:

1. Explain need of modulation, techniques in communications and overview of electromagnetic spectrum.
2. Analyze analog, pulse and digital modulation techniques.
3. Distinguish various communication networks and their topologies.
4. Conceptualize principles and applications of satellite and optical communications.
5. Comprehend various cellular telephone systems and wireless technologies.

Unit 1: Introduction to Electronic Communication [4 Hrs]

Basics of Electronic Communication: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels. Self Study: Probability Density function.

Unit 2: Modulation Techniques [8 Hrs]

Simple description on Modulation: Analog Modulation – AM, FM; Pulse Modulation – PAM, PWM, PCM; Digital Modulation Techniques – ASK, FSK, PSK, QPSK modulation and demodulation schemes. Self Study: VSB in TV Transmission.

Unit 3: Telephone Systems [4 Hrs]

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony. Communication Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN. Self Study: Repeaters & Equalizers.

Unit 4: Satellite Communication [6 Hrs]

Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations, Satellite Applications, Global Positioning Systems. Optical Communication: Optical Principles, Optical Communication Systems, Fiber Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing. Self Study: Case study PSLV.

Unit 5: Mobile Communication [6 Hrs]

Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA. Wireless Technologies: Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, WiMAX and MANs, Infrared wireless, RFID communication, UWB. Self Study: Seamless Connectivity.

Textbooks

[1] Principles of Electronic Communication Systems, Louis E. Frenzel, Fourth Edition, McGraw Hill, 2016.
[2] Satellite Communication by Monojit Mitra, PHI, 2008.
[3] Textbook of Optical Fiber Communication by SK Kataria.

Reference Books

[1] Electronic Communications Systems, Kennedy, Davis 4e, McGraw Hill Education, 1999.
[2] Theodore Rappaport, Wireless Communications – Principles and Practice, Prentice Hall, 2002.
[3] Roger L. Freeman, Fundamentals of Telecommunications, Second Edition, Wiley.

[4] Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education, 2005.

Note

[1] To measure CO1, questions may be of the type: define, identify, state, match, list, name etc.
[2] To measure CO2, questions may be of the type: explain, describe, illustrate, evaluate, give examples, compute etc.
[3] To measure CO3, questions will be based on applications of core concepts.
[4] To measure CO4, questions may be of the type: true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
[5] To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.