Dr. Babasaheb Ambedkar Technological University, Lonere

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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Structure and Detailed Syllabus

for

Minor in Electronics and Telecommunication Engineering

In line with New Education Policy 2020

(Effective from Academic year 2024-25 for main campus)

List of Courses for Minor in E&TC

Sr. No	Course Code	Course Name	Semester	Credits	Instructor	Organizing Institute	Reference SWAYAM/NPTEL Link
1	24UD1372MD306A	Electronic Devices & Circuits	3	2	Prof. Pradip Mandal	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_ee106/preview
	24UD1372MD306B	Digital Electronics			Prof. Goutam Saha	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc22_ee55/preview
2	24UD1372MD406A	Signals and Systems	4	2	Prof. Kushal K. Shah	IISER Bhopal	https://onlinecourses.nptel.ac.in/noc21_ee28/preview
	24UD1372MD406B	Network Theory			Prof. Tapas Kumar Bhattacharya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc22_ee07/preview
3	25UD1372D506A	Digital Signal Processing	5	3	Prof. S.C. Dutta Roy	IIT Delhi	https://nptel.ac.in/courses/117102060
	25UD1372MD506B	Electromagnetic Wave Theory			Prof. R.K. Shevgaonkar	IIT Bombay	https://nptel.ac.in/courses/117101056
4	25UD1372MD606A	Analog Circuits	6	3	Prof. Jayanta Mukherjee	IIT Bombay	https://onlinecourses.nptel.ac.in/noc22_ee15/preview

	25UD1372MD606B	Microprocessors			Prof. Santanu Chattopadhyay,	IIT Kharagpur,	https://onlinecourses.nptel.ac.in/noc22_ee12/preview
5	26UD1372MD706A	Antenna and Wave Propagation	7	2	Prof. Girish Kumar	IIT Bombay	https://onlinecourses.nptel.ac.in/noc20_ee20/preview
	26UD1372MD706B	Analog Communication			Prof. Goutam Das	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc21_ee74/preview
6	26UD1372MD806	Digital Communication	8	2	Prof. Bikash Kumar Dey	IIT Bombay	https://nptel.ac.in/courses/117101051

Electronics Devices and Circuits

Course Objectives:

1. To brief about Semiconductor devices JFET & MOSFET, its characteristics, parameters and applications.
2. To discuss MOSFET DC and AC Configurations and it"s analysis.
3. To explain various MOSFET Circuits
4. To introduce concepts of feedbacks in amplifiers & oscillators.
5. To impart skills to evaluate the performance of voltage regulator and SMPS Circuits

Course Outcomes:

CO1: Compare the characteristics and parameters of JFET towards its applications.
CO2: Compare the characteristics and parameters of MOSFET towards its DC circuits.
CO3: Explain various MOSFET circuits and their applications.
CO4: Explain MOSFET amplifiers with and without feedback & MOSFET oscillators, for given specifications.
CO5: Analyze the performance of linear and switching voltage regulators towards applications in regulated power supplies.

UNIT – 1 Bipolar Junction Transistor: (06 hrs.)

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier, Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier.

UNIT – 2 Junction Field Effect Transistor and MOSFET (06 hrs.)

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers , Biasing the FET.

MOSFET: Overview of DMOSFET, EMOSFET, n-MOSFET, p-MOSFET and CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances.

CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT III Power amplifiers: (06 hrs.)

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, calculation of efficiency of (transformer coupled class A amplifier, Class B push pull), calculation of power output, power dissipation.

UNIT IV- Feedback amplifiers & Oscillators (6 hrs.)

Feedback Amplifiers: Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt, Current series, Current shunt types of Negative feedback, Typical transistor circuit effects of Negative feedback on Input and Output impedance, Voltage and Current gains.

Oscillators: Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, Resonant frequency calculation of (General form of LC oscillator, FET RC Phase Shift oscillator, Wein bridge oscillator, Hartley and Colpitts oscillators).

UNIT V- Voltage Regulator & Switched Mode Power Supply (SMPS) (6 hrs.) **Transistor application:** Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator. Introduction to Switch Mode Power supply (SMPS), Block diagram of SMPS, Types of SMPS.

TEXT/REFERENCE BOOKS:

1. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, "Electronics Devices & Circuits", Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.
8. V.K. Mehta, Rohit Mehta, Principles of Electronics, S. Chand and Company
9. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 11^{th} Edition.

Digital Electronics

1. To acquaint the students with the fundamental principles of two-valued logic and Various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

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

CO1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.

CO2. Design combinational and sequential circuits.

CO3. Design and implement hardware circuit to test performance and application.

CO4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT 1: Combinational Logic Design:

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and Demultiplexers, Decoders.

UNIT 2: Sequential Logic Design

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops and Conversion of flip flops. Application of Flip- flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT 3: State Machines

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT 4:Digital Logic Families

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2 L and DCTL.

UNIT 5: VHDL

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India,2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd 2001 Edition.

Signals and Systems

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyse Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

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

CO1: Understand mathematical description and representation of continuous and discrete time signals and systems.

CO2: Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.

CO3: Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.

CO4: Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

UNIT 1: Introduction to Signals and Systems

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding, Sampling Theorem and reconstruction of sampled signal, Concept of aliasing, examples on under sampled and over sampled signals. Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT 2 Time domain representation of LTI System

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulse response.

UNIT 3 Fourier Series

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties.

UNIT 4 Fourier Transform

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard, CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of band-pass signals.

UNIT 5 Laplace and Z-Transform

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI system analysis. Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z-transform, Z-transform for discrete time system LTI analysis.

TEXT/REFERENCE BOOKS:

1. Alan V. Oppenheim. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, WileyIndia.
4. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.
5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press,2007.
6. Peyton Peebles, “Probability, Random Variable, Random Processes”, 4th Edition, Tata McGraw Hill.
7. A. NagoorKanni “Signals and Systems”, 2nd edition, McGrawHill.
8. NPTEL video lectures on Signals and Systems.
9. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw Hill.2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th 2001 Ed., Pearson Education.

Digital Signal Processing

1. To introduce students with transforms for analysis of discrete time signals and systems.
2. To understand the digital signal processing, sampling and aliasing.
3. To use and understand implementation of digital filters.
4. To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real-world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

Module 1:

DSP Preliminaries: 07 Hours

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

Module 2

Discrete Fourier Transform: 07 Hours

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm.

Module 3

Z transform: 07 Hours

Need for transform, relation between Laplace transform and Z transform, between Fourier Transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behaviour, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Module 4

IIR Filter Design: 07 Hours

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Low pass filter).

Module 5:
FIR Filter Design and introduction to MDSP: 07 Hours
Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and omparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form. Introduction to Multirate signal processing: Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter banks, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS:

1. S. K. Mitra, Digital Signal Processing: A computer-based approach, TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall,1992.
5. J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley & Sons, 1988.

Electromagnetic Wave Theory

Course objectives:

1. To provide a foundational understanding of electromagnetic (EM) waves and various techniques of communication, preparing students for advanced study in communication
2. To introduce students to the basic laws of electromagnetics, vector calculus, and the formulation and application of Maxwell's equations in various media systems.
3. To impart knowledge on the propagation of uniform plane waves, including wave polarization, phase velocity, power flow, and the Poynting vector.
4. To familiarize students with practical applications of transmission lines, including the use of Smith charts for impedance matching and analysis. **Course outcomes:**

CO1: Explain fundamental EM wave concepts and communication techniques.

CO2: Derive and solve transmission line equations; calculate propagation constant and characteristic impedance.

CO3: Understand and apply Maxwell's equations and boundary conditions.

CO4: Analyze uniform plane waves, wave polarization, phase velocity, and power flow.

CO1: Predict wave behavior at media interfaces, including reflection, refraction, and polarization.

CO5: Use Smith charts for impedance matching and transmission line analysis.

Module 1 Introduction and Transmission line: **7 hours**

Introduction to EM waves and various techniques of communication, Equations of Voltage and Current on TX line, Equations of Voltage and Current on TX line, Propagation constant, Characteristic impedance and reflection coefficient, Impedance Transformation, Loss-less and Low loss Transmission line and VSWR, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines.

Module 2 Maxwell's Equation: **7 hours**

Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Module 3 Uniform plane Wave: **7 hours**

Uniform plane wave, Propagation of wave, Wave polarization, Pioncere 's Sphere, Wave propagation in conducting medium, Wave propagation and phase velocity, Power flow and Pointing vector, Surface current and power loss in a conductor.

Module 4 Plane wave at Media interface: **7 hours**

Plane wave in arbitary direction, Plane wave at dielectric interface, Reflection and refraction at media interface, Total internal reflection, Polarization at media interface, Reflection from a conducting boundary.

REFERENCE BOOKS:

1. David K. Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson Education India, 1989.
2. William H. Hayt, Jr. and John A. Buck, "Engineering Electromagnetics", 8th Edition.
3. David M. Pozar, "Microwave Engineering", 4th Edition, Wiley, 2011. McGraw-Hill Education, 2011.
4. Matthew N.O. Sadiku, "Elements of Electromagnetics", 6th Edition, Oxford University Press, 2014.

Microprocessors

Course objectives:

1. Familiarize basic architecture of 8085 microprocessor 2.
Program 8085 Microprocessor using Assembly Level Language
3. Handling interrupts in 8085.
4. Understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design
5. Understand the architecture of 8086.

Course Outcomes:

CO1: Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
CO2: Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
CO3: Students can identify and formulate control and monitoring systems using microprocessors.
CO4: Learn use of hardware and software tools.
CO5: Develop interfacing to real world devices.
CO6: Graduates will be able to design real time controllers using microcontroller-based system.
CO7: Learn importance of microcontroller in designing embedded application.

Unit 1: Fundamentals of Microprocessor

Basic 8085 microprocessor architecture and its functional blocks, 8085 microprocessor IC pin outs and signals.

Unit 2: Programming with 8085

Assembly Language Programming Basics, Addressing Modes, Instruction set of microprocessor, Instruction timing diagram. Writing, Assembling & Executing Assembly Language Programs.

Unit 3: Interrupts

Interrupt structure of 8085 microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

Unit 4: Interfacing Memory Interfacing

Interfacing with 8255 Programmable Peripheral Interface, 8254 Programmable Interval Timer, 8279 Display controller, Interrupt controller 8259.

Unit 5: Introduction of 8086 Microprocessor Detail Architecture of 8086, Addressing Modes, Assembler directives, Co-Processor.

TEXT/REFERENCE BOOKS:

1. Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.
2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
3. M. A. Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearsonedu.
4. Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing, Cengage Learning, Jan2011.
5. David Calcutt, 8051 microcontrollers: Applications based introduction, Elsevier.
6. Udayashankara V., MallikarjunaSwamy, 8051 microcontroller,TMH.
7. K. J. Ayala, 8051 microcontroller, Cenage (Thomson).

Network Theory

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
3. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
4. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:
On completion of the course, students will be able to:
CO1: Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze the same.
CO2: Design passive filters and attenuators theoretically and practically.
CO3: To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
CO4: Identify issues related to transmission of signals, analyze different RLC networks. CO5: Find technology recognition for the benefit of the society.

Module 1- Network Theorems
Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin‟s, Norton‟s and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

Module 2 Transient Analysis and Frequency Domain Analysis:
Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

Module 3 Laplace transform and its circuit applications
Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency esponse.

Module 4 Two Port Networks:
Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

Module 5 State Variable Analysis and RL & RC Network Synthesis:
State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press.2003.
3. M.E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson2006.
4. M.E. Van Valkenburg, "Network Synthesis," PHI2007.
5. Kuo, F.F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.2008.
6. D Roy Choudary, "Network and Systems" 1st edition, New Age International,1988
7. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill,1982.
8. Royal Signal Handbook on Line Communication.

Analog Communication

1. The fundamental principles of analog communication systems, including modulation techniques, signal transmission, and reception.
2. To analyze various analog modulation techniques such as amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM), understanding their advantages, disadvantages, and applications.
3. To understand the process of signal transmission through analog communication channels, including the effects of noise, attenuation, and distortion, and methods to mitigate these effects.
4. To study the different demodulation techniques for extracting the original message signal from modulated carrier waves, such as envelope detection, synchronous detection, and coherent detection.
5. To comprehend the sources of noise and distortion in analog communication systems, such as thermal noise, intermodulation distortion, and phase noise, and strategies to minimize their effects.
6. To explore real-world applications of analog communication systems, including radio broadcasting, television transmission, and voice communication, understanding their technological evolution and current trends.

Course Outcomes:

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

CO1: To demonstrate a thorough understanding of analog modulation techniques, including amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM), and their applications in communication systems.CO2: Choose specific modulation technique as per system requirement.

CO2: To analyze analog signals in both time and frequency domains, including their spectra, bandwidth, and modulation index, using mathematical tools and simulation software.

CO3: To acquire knowledge of demodulation techniques used to recover the original message signal from modulated carrier waves, such as envelope detection, synchronous detection, and coherent detection.

CO4: To understand the effects of noise and distortion on analog communication systems, including thermal noise, intermodulation distortion, and phase noise, and methods to mitigate these effects.

CO5: To enhance the critical thinking and problem-solving skills by analyzing trade-offs between different modulation techniques, channel bandwidth requirements, and system complexity, and proposing solutions to optimize system performance.

CO6: To enhance their critical thinking and problem-solving skills by analyzing trade-offs between different modulation techniques, channel bandwidth requirements, and system complexity, and proposing solutions to optimize system performance.

UNIT – 1 Introduction to Communication System **07 Hours**

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation, sampling theorem and pulse analog modulation, multiplexing: TDM, FDM.

UNIT – 2 Amplitude Modulation **07 Hours**

Introduction, Mathematical analysis and expression for AM, Modulation index, Frequency spectrum and bandwidth of AM, Power calculations, Generation of AM using nonlinear property, Low and high level modulation, Balance Modulator.

Types of AM: DSB-FC, DSB-SC, SSB-SC, ISB and VSB, their generation methods and comparison.

UNIT – 3 Angle Modulation **07 Hours**

Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct and indirect methods of FM generation, Pre emphasis and de-emphasis, Comparison of AM, FM and PM.

UNIT – 4 Radio Receivers and Demodulators **07 Hours**

Introduction, Performances characteristic of receivers: Sensitivity, Selectivity, Fidelity, Image frequency and IFRR, Tracking and Double spotting, TRF, Super heterodyne receivers, RF amplifier, Local oscillator and mixer, IF amplifier, AGC.

UNIT – 5 AM and FM Detectors and noise **07 Hours**

AM Detectors: Envelop detector and practical diode detector.

FM Detectors: Slope detector, phase discriminator and ratio detector.

Noise: Introduction, Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.

TEXT/REFERENCE BOOKS:

1. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4th Edition.
2. Anokh Singh, "Principles of communication engineering"S.Chand
3. Roddy&Coolen, "Electronic communication"PHI
4. Taub & Schilling "Principles of communication systems" Tata Mc GrawHill
5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.
6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.
7. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill NewDelhi-2008.

Analog Circuits

1. To understand characteristics of IC and Op-Amp and identify the internal structure.
2. To introduce various manufacturing techniques.
3. To study various op-amp parameters and their significance for Op-Amp.
4. To learn frequency response, transient response and frequency compensation technique for Op-Amp.
5. To analyze and identify linear and nonlinear applications of Op-Amp.

Course Outcomes:

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

CO1: Understand the characteristics of IC and Op-Amp and identify the internal structure.

CO2: Understand and identify various manufacturing techniques.

CO3: Derive and determine various performances-based parameters and their significance For Op-Amp.

CO4: Verify parameters after exciting IC by any stated method.

CO5: Analyze and identify the closed loop stability considerations and I/O limitations CO6: Analyze and identify linear and nonlinear applications of Op-Amp.

CO7: Understand and verify results (levels of V & I) with hardware implementation.

CO8: Implement hardwired circuit to test performance and application for what it is being designed.

UNIT 1: Introduction to operational Amplifiers

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots. Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.

UNIT 2: Linear applications of operational amplifiers:

Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.

UNIT 3: Non-linear applications of operational amplifiers:

Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.

UNIT 4: Oscillators

Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square triangle oscillators.

UNIT 5: Analog and Digital interface circuits:
Analog and Digital interface circuits: Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc., V-F, I-V and V-I converter.

TEXT/REFERENCE BOOKS:

1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York,1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill,1988.P.
3. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.
4. A. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV.
5. Paul R. Gray & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rdEdition.
6. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
7. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India2008.
8. George Clayton and Steve Winder, “Operational Amplifiers”, 5th EditionNewnes.
9. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGrawHill.
10. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.Gray, Hurst, Lewise, Meyer, 11. “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

Digital Communication

1. To understand the building blocks of digital communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a digital communication system.
4. To analyze error performance of a digital communication system in presence of noise and other interferences.
5. To understand concept of spread spectrum communication system.

Course Outcomes:

CO1: Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.

CO2: Perform the time and frequency domain analysis of the signals in a digital communication system.

CO3: Select the blocks in a design of digital communication system. 4. Analyze Performance of spread spectrum communication system.

Unit 1:

Digital Transmission of Analog Signal:

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speechsynthesis.

Unit 2:

Baseband Digital Transmissions:

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

Unit 3:

Random Processes:

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

Unit 4:

Baseband Receivers:

Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

Unit 5:

Passband Digital Transmission & Spread Spectrum Techniques:

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying,

Spread Spectrum Techniques: Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum.

TEXT/REFERENCE BOOKS:

1. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, “A First Course in Digital Communication”, Cambridge University Press.
4. B P Lathi, Zhi Ding “Modern Analog and Digital Communication System”, Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications” Second Edition, Pearson Education
6. Taub, Schilling, “Principles of Communication System”, Fourth Edition, McGrawHill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

Antenna and Wave Propagation

1. To understand the applications of electromagnetic engineering.
2. To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
3. To analyze and understand the Uniform plane wave propagation in various media.
4. To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:
After successfully completing the course students will be able to

CO1: Formulate the wave equation and solve it for uniform plane wave.
CO2: Analyze the given wire antenna and its radiation characteristics. CO3:
Identify the suitable antenna for a given communication system.

UNIT 1: Wave Propagation
Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth‟s curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth‟s magneticfield. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and CoherenceTime.

UNIT 2: Antenna Fundamentals and Wire Antennas
Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.
Wire Antennas: Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT 3: Antenna Arrays
Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, non-uniform amplitude, array factor, binomial and DolphTchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT 4: Concepts of Smart Antennas
Introduction, Smart Antenna Analogy, Cellular Radio System Evolution, benefits and drawbacks of smart antennas, fixed weight beam forming basics, Antenna beamforming.

UNIT 5: Antennas and Applications
Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors. **Text /Reference Books:**

1. Shevgaonkar, R. K., “Electromagnetic waves”, Tata McGraw-Hill Education, 2006.
2. Balanis, Constantine A., “Antenna theory: analysis and design”, John wiley& sons,2016.
3. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press.
4. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
5. K. D. Prasad, “Antenna & Wave Propagation”, SatyaPrakashan, NewDelhi.
6. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill,2010.
7. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.