COURSE STRUCTURE & SCHEME

For

B.TECH
SECOND YEAR

In

Electronics and Communication Engineering

Electronics and Communication Engineering Department
Institute of Engineering and Technology
AKTU Technical University, Lucknow - 226 021
www.ietlucknow.ac.in

VISION AND MISSION OF THE INSTITUTE

VISION

To effectively contribute towards the national endeavor of producing world class manpower and to usher in technology driven economic development of the country in order to enrich the quality of life of its citizen by promoting innovative technologies and optimal utilization of resources for sustainable development.

MISSION

M1: To establish global state-of-art facilities and resources that will prepare and enrich the human resource by promoting all-inclusive research and developments.

M2: To inculcate entrepreneurship skills in the students in order to optimize resources to achieve the economic growth by improving the quality of life of the citizens.

M3: To instill problem-solving skills for overcoming real life challenges by imparting values based professional education.

VISION AND MISSION OF THE DEPARTMENT

VISION

To produce manpower in the field of Electronics and Communication Engineering, capable to compete with that elsewhere and to make the department a center of excellence in the field of Signal Processing and Microelectronics.

MISSION

M1: To develop the ability among students and understand concepts of core graduate electronics and communication engineering.

M2: To create center of Excellence to meet global research and development challenges.

M3: To build student community with professional and ethical standards in thrust areas so as to meet industry requirements.

Program Educational Objectives (PEOs)

Undergraduate education in Electronics and Communication Engineering Department at Institute of Engineering and Technology (I.E.T), Lucknow inculcates the following capabilities

- Use technical, teamwork and communication skills along with leadership principles to pursue Electronics and Communication Engineering careers in areas such as Electronic Circuits, Instrumentation and Controls, Communication Engineering, VLSI Design and Signal Processing.
- To develop the students with computational skills suitable to industrial needs of Indian and multi-national companies.
- To train the students to use modern engineering techniques, skills and tools and to function ethically in their professional Electronics and Communication Engineering roles.
- Engage in life-long learning through independent study and by participating in professional conferences, workshops, seminars or continuing education program.

PEO1: Graduates of the programme will have an educational experience that inspires them to exhibit leadership and team building skills and have successful careers in their chosen technical or professional domain.

PEO2: Graduates of the programme will continue to learn and adapt in a constantly evolving society and contribute to the society in a professional and ethical manner.

PEO3: Graduates of the programme will inculcate good technical and professional knowledge according to requirements of industries and higher studies.

PEO4: To inculcate the spirit of innovation / creativity, independent thinking, risk taking ability, entrepreneurship and attitude to approach challenges with confidence.

SYLLABUS FOR SESSION-2023-24
B.TECH. SECOND YEAR (III Semester)
(ELECTRONICS AND COMMUNICATION ENGG.)

Semester III													
Sr. No.	**Course Code**	**Course Title**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1.	IOE031-39/IAS302	Engg. Science Course/ Maths IV	3	1	0	20	10	30		70		100	4
2.	IAS301/ IVE301	Technical Communication/ Universal Human Values	2 3	1 0	0 0	20 20	10 10	30 30		70		100	3
3.	IEC301	Electronics Devices & Circuits	3	1	0	20	10	30		70		100	4
4.	IEC302	Digital Logic Design	3	1	0	20	10	30		70		100	4
5.	IEC303	Electromagnetic Field Theory & Wave Propagation	3	1	0	20	10	30		70		100	4
6.	IEC351	Electronics Devices & Circuit Lab	0	0	2				50		50	100	1
7.	IEC352	Digital Logic Design Lab	0	0	2				50		50	100	1
8.	IEC353	Circuit Simulation Lab	0	0	2				50		50	100	1
9.	IEC354	Mini Project or Internship	0	0	2						100	100	1
10.	INC301/ INC302	Computer System Security /Python Programming						50		50			0
11.		MOOCs (Essential For Hons. Degree)											
		TOTAL										900	23
*The Mini Project or Internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.													

B.TECH. SECOND YEAR (IV Semester)													
Sr. No.	**Course Code**	**Course Title**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1.	IAS402/ IOE041-49	Maths IV / Engg. Science Course	3	1	0	20	10	30		70		100	4
2.	IVE401/ IAS401	Universal Human Values/ Technical Communication	2 3	1 0	0 0	20 20	10 10	30 30		70		100	3
3.	IEC401	Computer Organisation and Architecture	3	1	0	20	10	30		70		100	4
4.	IEC402	Network Analysis and Synthesis	3	1	0	20	10	30		70		100	4
5.	IEC403	Signal System	3	1	0	20	10	30		70		100	4
7.	IEC451	Computer Organisation and Architecture Lab	0	0	2				50		50	100	1
8.	IEC452	Network Analysis and Synthesis Lab	0	0	2				50		50	100	1
9.	IEC453	Signal System Lab	0	0	2				50		50	100	1
10.	IEC 454	Instrumentation and Sensor Lab	0	0	2				50		50	100	1
11.	INC402/ INC401	Python Programming / Computer System Security						50		50			0
12.		MOOCs (Essential For Hons. Degree)											
		TOTAL										900	23

Syllabus

B.Tech 2nd Year
III Semester

IEC301	Electronics Devices and Circuits	3L:1T:0P	4 Credits

Pre-requisite: Fundamentals of Electronics Engineering

Course Objectives:

1. Get familiar with quantum mechanics, semiconductor physics and energy bands. Knowledge about excess carrier in semiconductor material and its various Junction Properties.
2. Analyze BJT as amplifier, its /high frequency response and small signal models
3. To understand working of MOS capacitor, MOSFET and their characteristics
4. To understand the concept of feedback topologies and various oscillators.

	IEC 301: Electronics Devices and Circuits		
UNIT	**Topic**	Chapter reference	Lectures
1	Energy bands in intrinsic and extrinsic silicon, carrier transport, diffusion current, drift current, mobility and resistivity, sheet resistance, design of resistors. Excess Carriers in Semiconductors: Optical absorption, luminescence, carrier life time and photo conductivity, diffusion of carriers. Junction Properties: Equilibrium conditions, biased junctions, steady state conditions, reverse bias break down, transient and AC conditions.	3.1- 3.4 [1] 4.1- 4.4[1]	**8**
2	BJT amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc.,	5.3 - 5.9[2]	**8**
3	High frequency transistor models, design procedure for particular specifications, low frequency analysis of multistage amplifiers MOSFET: Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier		
4	Feedback: The general feedback structure, properties of negative feedback, the four basic feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.		
5	Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.		**8**

Text Books:

[1] B. G. Streetman and S. Banerjee "Solid state electronics devices", 6th Edition, PHI.
[2] A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 5th Ed

Reference Books:

[3] D. Neamen, D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
[4] J. Millman and A. Grabel, "Microelectronics," 2nd edition, McGraw Hill, 1988.
[5] Paul R. Gray and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits," John Wiley, 3rd edition.
[6] Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

Course outcomes: At the end of this course students will be able to:

CO1: Comprehensive understanding of semiconductor physics, carrier transport, P-N junctions, I-V characteristics, and device modeling.

CO2: Calculate and analyze carrier lifetime, understanding its impact on device performance and operation.

CO3: Understand the concept of BJT operation, amplification, biasing, small-signal models, and frequency response in amplifier circuits.

CO4: Analyze the concept of Biasing in MOS amplifier circuits and high frequency models.

CO5: Understand the concept of feedback topologies and principles of oscillator circuits.

IEC302	Digital Logic Design	3L:1T:0P	4 Credits

Pre-requisite: Fundamentals of Electronics Engineering

Course Objectives:

1. Introduce the concept of digital and Binary system.
2. Design and analyze combination logic circuits.
3. Design and analyze sequential logic circuits.
4. Design and analyze DAC and ADC circuits, identifying the strengths and limitations of different architectures
5. Use Hardware Description Languages (HDLs) to model and simulate digital designs, and understand the design flow from HDL to hardware implementation.

Unit	Topics	Chapter/reference	Lectures
1	**Combinational logic**: Signed binary numbers, Binary codes & code conversion, NAND and NOR implementation two level and multilevel Boolean expression, Minimization of Boolean expression using Karnaugh Map & Quine Mc-Clusky method (Tabular method) MSI device like Half and full adders, subtractors, serial and parallel adder, BCD adder, Decoders, Encoders, Multiplexed, DE - multiplexers & Magnitude comparator, display,	1,2 &4 [1]	8
2	**Sequential Logic Circuits**: Introduction to Sequential logic design: Building blocks like S-R, JK and Master-Slave JK FF, edge triggered FF, characteristics table. Analysis of Clock Sequential circuits: state table, Reduction of state table, Excitation table State Diagram design of clock sequential circuits. Synchronous and asynchronous counters, shift registers, Introduction to finite state machines, design of synchronous FSM, algorithmic state machines charts. Designing synchronous circuits like pulse train generator, pseudo random binary sequence generator, clock generation.	5&8 [1]	8
3	**Logic families and semiconductor memories:** Introduction to Logic Families, characteristics Logic Families, fan-in, fan-out, Power Dissipation Speed of operation, noise margin, Operating Temperature, Tristate TTL and NAND gate, specifications, propagation delay, , tristate TTL, ECL, CMOS families and their interfacing, MUX implementation using CMOS, memory elements, concept of programmable logic devices like PAL, PLA and FPGA, logic implementation using programmable devices.	8 [1]	8
4	**Digital-to-Analog converters (DAC):** Introductions to Digital-to-Analog converters using Weighted resistor, R-2R ladder and resistor string etc. Analog-To-Digital converters (ADC): Using single slope, dual slope, successive approximation, and flash etc. switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.	7 [2]	8
5	**Introduction to Hardware Description Languages (HDL)**: Introduction to HDL, Design flow using HDL (VHDL or Verilog), Behavioral, Dataflow, and Structural modeling, Simulation and verification of digital designs, Introduction to synthesis and implementation tools, Implementation of combinational circuits Adder, subtractor and MUX, Implementation of sequential circuits : Latch, flip flops and counters.	9 [2]	8

Text Books:

[1] M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.

[2] S.Salivahanan and S.Arivazhagan, "Digital Circuits and Design" 3th edition, 2009.

Reference Books:

[3] R.P. Jain, "Modern Digital Electronics," Tata McGraw Hill, 4th edition, 2009.

[4] Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018.

[5] W.H. Gothmann, "Digital Electronics- An Introduction to Theory and Practice," PHI, 2nd edition, 2006.

[6] D.V. Hall, "Digital Circuits and Systems," Tata McGraw Hill,

IEC303	Electromagnetic Field Theory and Wave Propagation	3L:1T:0L	4 Credits

Pre-requisite: Engineering Mathematics, Intermediate Physics

Course Objectives:

1. Understand the fundamentals of vector calculus, electrostatics, and magnetostatics.
2. Describe static and dynamic electric and magnetic fields with the help of Maxwell's equations.
3. Analyze the behavior of plane waves in different media.
4. Understand wave phenomena in transmission line.
5. Examine the phenomenon of wave propagation and reflection in different media.

Unit	Topics	Chapter/reference	Lectures
1	**Vector Calculus:** Scalar and vector fields, vector representation of line, surface, volume integral, gradient, divergence and curl, divergence and Stokes theorem, different coordinate systems. **Electrostatic and Magnetostatics:** Coulomb's law, surface and volume charges, electrostatic potential, Gaussian law and its applications in field determination, Laplace's and Poisson's equation, Ampere's law, Biot Savart's law, magnetic flux density, magnetic vector potential, magnetic forces, Faraday's law, boundary conditions at electric and magnetic interfaces.	1,2,3,4,7 [1]; 1,2,3,7,8 [2]	8 L
2	**Time Varying Fields and Maxwell's Equations:** Displacement current, Maxwell's equation (integral & differential form) - for static, time varying and harmonically varying fields, Poynting theorem and power flow, complex pointing vector, properties of conductor and dielectrics, wave equations for free space and conductors.	4, 9, [1] 10[2]	8 L
3	**Uniform Plane Waves:** Uniform plane wave propagation, their transverse nature, reflection by ideal conductor: normal incidence, reflection and transmission with normal incidence at another dielectric, plane wave in lossy dielectric, surface & wave impedance and propagation constant, depth of penetration.	10[1]; 13[2]	8 L
4	**Transmission Lines:** Parallel plane transmission lines, transmission lines with losses, characteristic impedance, propagation constant, attenuation constant and phase constant, reflection, input impedance in terms of reflection coefficient, standing wave ratio (SWR), voltage maxima and minima, impedance matching devices and its principle, Smith chart.	11[1]; 11[2];	8 L
5	**Ground Wave Propagation:** Plane earth reflection, space wave and surface wave, space wave propagation: introduction, field strength relation, effects of imperfect earth, effects of curvature of earth. **Sky Wave Propagation**: Introduction, structural details of the ionosphere, wave propagation mechanism, refraction and reflection of sky waves by ionosphere, ray path, critical frequency, MUF, LUF, OF, virtual height and skip distance, relation between MUF and the skip distance, multi-hop propagation, wave characteristics.	4 [4]; 5 [3]	8 L

Text Books:
[1] Sadiku, M.N.O, Principles of Electromagnetics, Oxford University Press, 6th edition
[2] Hayt, W.H., Engineering Electromagnetic, Tata McGraw, 8th edition.
[3] John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 4th, Tata McGraw Hill.

Reference Books:
[4] Kraus, J.D., Electromagnetics, McGraw-raus, J.D., 5th edition.
[5] B,N, Basu, Engineering Electromagnetics Essentials, Universities Press.

NPTEL Lectures Link:
1. https://archive.nptel.ac.in/courses/108/104/108104087/
2. https://onlinecourses.nptel.ac.in/noc21_ee83/preview

Course Outcomes (CO s): The students will be able to:

CO1: Apply vector calculus in co-ordinate representation and analyze the static behavior of electric and magnetic fields.

CO2: Analyze the time varying fields using Maxwell's equations.

CO3: Investigate the characteristics of electromagnetic wave and its propagation in free space.

CO4: Analyze the behavior of electromagnetic wave and its propagation in transmission line.

CO5: Investigate the behavior of ground, space and sky wave propagation.

IEC351	Electronics Devices & Circuit Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS

1. **Characteristic of BJT:** BJT in CE configuration- graphical measurement of h-parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
2. **Study of Multi-stage amplifiers:** Frequency response of single stage and multistage amplifiers.
3. **Feedback topologies:** Study of voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc.
4. **Field effect transistors:** Single stage common source FET amplifier –plot of gain in dB vs frequency, measurement of bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
5. **Metal Oxide Semiconductor Field Effect Transistors**: Single stage MOSFET amplifier plot of gain in dB Vs frequency, measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
6. **Oscillators:** Study of sinusoidal oscillators:
   (i) RC oscillators (phase shift, Wien bridge etc.).
   (ii) Study of LC oscillators (Hartley, Colpitt, Clapp etc.),
7. Study of non-sinusoidal oscillators.
8. **Measurement of Op-Amp parameters:** Common mode gain, differential mode gain, CMRR, slew rate.

Simulation of amplifier circuits studied in the lab using any available simulation software and measurement of bandwidth and other parameters with the help of simulation software.

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: Analyze BJT CE amplifier, measure parameters and study multistage amplifier frequency response.

CO2: Analyze feedback's impact on gain, bandwidth across various topologies.

CO3: Explore FET and MOSFET amplifiers, analyze gain, bandwidth, impedance, signal capacity.

CO4: Learn oscillators: RC, LC, non-sinusoidal types and oscillator principles.

CO5: Measure Op-Amp parameters, explore applications: summing, integrator, differentiator.

IEC352	**Digital Logic Design Lab**	**0L:0T:2P**	**1 Credits**

SUGGESTIVE LIST OF EXPERIMENTS

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
2. Implementation of the given Boolean function using logic gates in both SOP and POSforms.
3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
4. Implementation and verification of Decoder using logic gates.
5. Implementation and verification of Encoder using logic gates.
6. Implementation of 4:1 multiplexer using logic gates.
7. Implementation of 1:4 demultiplexer using logic gates.
8. Implementation of 4-bit parallel adder using 7483 IC.
9. Design, and verify the 4-bit synchronous counter.
10. Design, and verify the 4-bit asynchronous counter.

Implementation of Mini Project using digital integrated circuits and other components.

Course outcomes: At the end of this course students will demonstrate the ability to:

CO1: Design and analyze combinational logic circuits.

CO2: Design & analyze modular combinational circuits with MUX/DEMUX, decoder, encoder.

CO3: Design & analyze synchronous sequential logic circuits

CO4: Design & build mini project using digital ICs.

IEC353	Circuit Simulation Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS
Implement experiments in part A in the PSPICE platform, while experiments of part B in VHDL/Verilog module.

Part A

PSPICE Experiments:

1. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.
2. Applications of PN Junction diode: Clipper and Clamper and Voltage Doublers circuit.
3. Characteristics of Zener diode: V-I characteristics of Zener diode, graphical measurement of forward and reverse resistance
4. (a) Transient Analysis of BJT inverter using step input.
   (b)DC Analysis (VTC) of BJT inverter
5. (a) Transient Analysis of NMOS inverter using step input.
   (b) Transient Analysis of NMOS inverter using pulse input.
   (c) DC Analysis (VTC) of NMOS inverter.
6. Analysis of frequency response of Common Source amplifiers.

Part B :

HDL (using VHDL program module/ VERILOG Module)

VHDL PROGRAMS

1. Design and Simulation of Half and Full Adder using VHDL **program module**
2. Design and Simulation of 4:1 MUX and 1:4 DMUX using VHDL **program module**
3. Design and Simulation of BCD to Excess-3 code using VHDL **program module**
4. Design and Simulation of 8 to 3 encoder and 3 to 8 decoder using VHDL **program module**
5. Design and Simulation of JK Flip-flop using VHDL **program module**

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: Analyze various application of PN junction diode (clipper, clamper, rectifier)

CO2: To implement transient and DC analysis of BJT invertor and NMOS invertor.

CO3: To implement adder and multiplexer.

CO4: Design encoder, decoder and code converter

CO5: Analyze behavior of a JK flip flop.

Syllabus

B.Tech 2nd Year
IV Semester

IEC401	COMPUTER ORGANIZATION AND ARCHITECTURE	3L:1T:0P	4 Credits

Pre-requisite: Digital Logic Design

Course Objectives:

1. To identify various components of computer and their interconnection
2. To understand design of the CPU, i.e. the ALU and control unit.
3. To compare among various Memory devices as per requirement.
4. To compare among various types of IO mapping techniques
5. To understand the performance issues of cache memory and virtual memory

Unit	Topics	Chapter/ reference	Lecture
I	**INTRODUCTION:** Computer Architecture, organization and design, Von- Neumann Architecture, basic organization of a computer, Data representation, Fixed and Floating point, Error detection and correction codes. **COMPUTER ARITHMETIC:** Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations.	1, 4[1] 11[1]	8
II	**BASIC COMPUTER ORGANIZATION AND DESIGN:** Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. **Central processing unit:** Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC. **Pipeline and Vector processing**: Pipeline structure, speedup, efficiency, throughput and bottlenecks. Arithmetic pipeline and Instruction pipeline.	6[1] 9[1] 10[1]	8
III	**REGISTER TRANSFER AND MICRO-OPERATIONS:** Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. **MICRO-PROGRAMMED CONTROL:** Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.	5[1] 8[1]	8
IV	**MEMORY ORGANIZATION:** Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Auxiliary memory, Associative memory, Cache Memory, Performance considerations, Virtual memory, Printer, Secondary Storage, RAID.	13[1] 15[1]	8
V	**INPUT OUTPUT ORGANIZATION:** I/O interface, Memory Mapped I/O, Programmed I/O, Interrupt Initiated I/O, DMA. **MULTIPROCESSORS:** Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.	12[1] 14[1]	8

TEXT BOOKS:

1. M. Moris Mano (2017), Computer System Architecture, revised 3rd edition, Pearson, India.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2011), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. William Stallings (2010), Computer Organization and Architecture- designing for performance,8th edition, Prentice Hall, New Jersy.
3. Anrew S. Tanenbaum (2013), Structured Computer Organization, 6th edition, Pearson,India
4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, McGraw Hill International edition

Course Outcomes: At the end of the course students will be able to:

CO1: Comprehensive understanding of computer architecture, operations, arithmetic, and error correction.

CO2: Mastery of computer organization, design, pipelines, CPUs, and performance trade-offs.

CO3: Proficiency in register transfer, micro-operations, control design, and microprogramming.

CO4: Comprehensive grasp of memory systems, hierarchies, cache, virtual memory, and storage technologies.

CO5: Proficiency in I/O methods, multiprocessor features, communication, synchronization, and coherence.

IEC402	Network Analysis and Synthesis	3L:1T:0P	4 Credits

Pre-requisite: Mathematics

Course Objectives:

1. Apply basics of electrical circuits with nodal and mesh analysis.
2. Illustrate electrical network theorems.
3. Understand the concept of Laplace and Fourier transform and transform circuits using Thevenin's and Norton's theorem.
4. Analyze electrical circuits under transient and steady state conditions.

Unit	Topics	Chapter/ reference	Lectures
1.	Node and mesh analysis, matrix approach of network containing voltage & current sources and reactances, source transformation and duality	2[1] 3[2]	8
2.	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tellegen's theorem as appliedto A.C. circuits.	3,5[1; 4[2]	8
3.	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non- sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra	11[1]; 7[2]	8
4.	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	12[1] 5[2]	8
5.	Transient behaviour, concept of complex frequency, driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, two-port network and interconnections. Introduction to band pass, low pass, high pass, and band reject filters.	9[1] 8[2]	8

Text Book

[1] A. Anand Kumar, "Network Analysis and Synthesis," PHI publication, 2019.
[2] A. K Chakrabory," Network Analysis and Synthesis," McGraw Hill publication, 2018.

Reference Books

[3] Franklin F. Kuo, "Network Analysis and Synthesis," Wiley India Education, 2nd Ed., 2006.
[4] Van, Valkenburg, "Network analysis," Pearson, 2019.
[5] Sudhakar, A., Shyammohan, S. P., "Circuits and Network," Tata McGraw-Hill New Delhi, 1994.
[6] A William Hayt, "Engineering Circuit Analysis," 8th Edition, McGraw-Hill Education.

Spoken Tutorial (MOOCs):

1. https://www.youtube.com/watch?v=bnjiLg4xfh8
2. https://www.youtube.com/watch?v=U8riFeiiu3s
3. https://www.youtube.com/watch?v=lkAvgVUvYvY
4. https://www.youtube.com/watch?v=Pq-tUQzeSRw
5. https://www.youtube.com/watch?v=15d-gyoBxIQ

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: Understand basics electrical circuits with nodal and mesh analysis.
CO2: Appreciate electrical network theorems.
CO3: Apply Laplace transform for steady state and transient analysis.
CO4: Determine different network functions.
CO5: Appreciate the frequency domain techniques.

IEC403	Signal System	3L:1T:0P	4 Credits

Course Objectives:

1. To understand the behavior of signals in time and frequency domain
2. To understand the characteristics of LTI systems
3. To give the concepts of signals and systems and its analysis using different transform techniques
4. To understand the Sampling and Reconstruction of signal

Unit	Topics	Chapter/ reference	Lectures
1	**SIGNALS AND THEIR REPRESENTATION** Analogy between vectors and signals, Orthogonal signal space, Orthogonality in complex functions, Eigen analysis, Continuous-time and Discrete-time signals, Energy and Power signals, Periodic and Aperiodic signals, Even and Odd signals, Exponential and sinusoidal signals etc., Transformations of the independent variable, Concepts of Unit impulse and Unit sample signals, Signum function. Continuous-time and Discrete-time systems and basic system properties.	1[1] 1[2]	8
2	**LINEAR TIME-INVARIANT (LTI) SYSTEMS AND FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS** Discrete and Continuous time LTI systems, Convolution Sum, Convolution Integral, Properties of LTI systems, Causal LTI systems described by difference equations, Singularity functions. Continuous-time and Discretetime signals and their Fourier Series representation, Properties of Fourier Series, Dirichlet's Conditions, Complex Fourier Spectrum.	2[1] 2[2]	8
3	**REPRESENTATION OF APERIODIC SIGNALS BY FOURIER TRANSFORMS AND LAPLACE TRANSFORMS** Continuous-time and Discrete-time signals and their Fourier Transforms, Fourier Transforms of periodic signals and standard signals, Properties of Fourier Transforms, System characterized by linear constant coefficient differential equation. Principles of Laplace Transform, The Region of Convergence (ROC), Properties of ROC, Relationship between Laplace Transform and Fourier Transform, Properties of Laplace transform.	3,9 [1] 5, 6[2]	8
4	**Z-TRANSFORMS** Principles of Z-Transform,The Region of Convergence (ROC), Propertiesof ROC, Relationship between Z-Transform and Fourier Transform, Properties of Z-transform, Inverse Z-transform, Pole zero plot, Power series expansion and Partial Fraction Expansion, Initial value and Final value Theorems, Analysis and characterization of LTI system using Z-Transforms.	10 [1] 13[2]	8
5	**SAMPLING AND RANDOM SIGNALS** Representation of Continuous-time signals by its samples, Sampling theorem, Impulse train sampling, Sampling with Zero Order Hold (ZOH), Natural and Flat top sampling, Reconstruction of signal from it's samples using interpolation, Effect of under sampling – Aliasing., Review of Probability Theory, Random signals and their representation, Continuous and Discrete Random variable, their description and examples, Statistical averages.	7[1] 15[2]	8

Text Books:

[1] "Signals and Systems" by A. V. Oppenheim, A. S Willsky, and S. H. Nawab, Prentice-Hall, Englewood Clieffs.

Reference Books:

[2] "Fundamentals of Signals and Systems" by Michel J. Robert, MGH International Edition

[3] "Signals & Systems & Communication" by B. P. Lathi, Bsp

[4] "Signals and Systems" by Simon Haykin and Van Veen, Wiley, 2nd Edition.

[5] "Probability, random variables and stochastic Processes" by A. Papoulis, McGraw-Hill.

Course Outcomes: On the completion of course, the student will be able to

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

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

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

CO4: Understand the limitation of Fourier transform and need for Laplace transform and Z transform and develop the ability to analyse the system in s domain and z domain

CO5: Understand the sampling theorem, al iasing, types of sampling, and reconstruction of signal from its samples along-with the introduction of random signals and probability theory

IEC451	Computer organization and Architecture Lab	0L:0T:2P	1 Credits

Implement experiments in part A in the trainer kit, while experiments of part B in C language.

SUGGESTIVE LIST OF EXPERIMENTS

Part A

1. To realize Half Adder and Full Adder using Basic gates and NAND gates
2. To realize Half Subtractor and Full Subtractor by using Basic gates and NAND gates
3. Design a 4 bit comparator using gates/IC.
4. Design and Implement a 4 bit shift register using Flip flops.
5. To set up and test a 7-segment static display system to display numbers 0 to 9.

Part B

To implement following programs in **C language**

1. Implement a C program to convert a Hexadecimal, octal, and binary number to decimal number vice versa.
2. Implement a C program to perform Binary Addition & Subtraction.
3. Implement a C program to perform Multiplication of two binary numbers
4. Implement a C program to perform Multiplication of two binary numbers (signed) using Booth's Algorithms.
5. Implement a C program to perform division of two binary numbers (Unsigned) using restoring division algorithm.
6. Implement a C program to perform division of two binary numbers (Unsigned) using non-restoring division algorithm.

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: To realize Half and full adder and subtractor.
CO2: To Understand basics of comparators, shift register and 7-segment static display.
CO3: To implement conversion of various binary system.
CO4: To implement Binary Addition & Subtraction.
CO5: To implement Binary multiplication and division.

IEC 452	**Network Analysis and Synthesis Lab**	**0L:0T:2P**	**1 Credits**

SUGGESTIVE LIST OF EXPERIMENTS

1. Verification of Kirchhoff's laws.
2. Verification of Superposition theorem.
3. Verification of Thevenin's Theorem and Maximum power transfer theorem.
4. Verification of Tallegen's theorem.
5. Measurement of power and power factor in a single phase AC series inductive circuit and study improvement of power factor using capacitor.
6. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
7. Determination of parameters of AC single phase series RLC circuit.
8. To find poles and zeros of immittance function.
9. Design and find cut-off frequency of low pass and high pass filters.
10. Design and find the pass band frequencies of band pass filters.
11. Design and find the stop band frequencies of band reject filters.

Course Outcomes: At the end of this course students will demonstrate the ability to:
CO1: Understand basics of electrical circuits with nodal and mesh analysis.
CO2: Appreciate electrical network theorems.
CO3: Analyse RLC circuits.
CO4: Determine the stability of an electrical circuit.
CO5: Design network filters.

Related Lab Video Links:
https://www.youtube.com/@electronicsplanet3272
https://www.youtube.com/watch?v=6-2AQWzjxuY&t=43s
https://www.youtube.com/watch?v=fBpCY12jxPU&t=33s
https://www.youtube.com/watch?v=ruuGNSpVrMw
https://youtu.be/Hv06P-RlQSU

IEC 453	**Signal System Lab**	**0L:0T:2P**	**1 Credits**

Implement following programs on MATLAB.

SUGGESTIVE LIST OF EXPERIMENTS

1. Plot the Frequency Spectrum of continuous time signals
2. Plot the Frequency Spectrum of discrete time signals
3. Write a program to generate the following discrete sequences: -
   (i) Unit Step (ii) Unit Impulse (iii) Unit Ramp (iv) Periodic sinusoidal sequences. Plot all the sequences.
4. Find the Fourier transform of a square pulse. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences and plot all the sequences. Verify the result by analytical calculation.
6. Write a program to find the Trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.
7. Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.
8. Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find the magnitude and phase response of the first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters.

Course outcomes: At the end of this course students will demonstrate the ability to:

CO1: Understand the concepts of continuous time and discrete time systems.
CO2: Implement the concept of Fourier series and Fourier transforms.
CO3: Analyze systems in complex frequency domain
CO4: Understand sampling theorem and its implications.

IEC 454	Instrumentation and Sensor Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS:

Part A (Sensor and Instrument)

1. Measurement of phase difference and frequency using CRO (Lissajous Figure)
2. Study of L.C.R. Bridge and determination of the value of the given components.
3. Characteristics of Thermocouples and RTD.
4. Study of the following transducer
    a. PT-100 Transducer
    b. J-Type Transducer
    c. KType Transducer
    d. Pressure Transducer
5. Characteristics of LDR, Photo Diode, and Phototransistor:
    e. Variable Illumination.
    f. Linear Displacement
6. Characteristics of LVDT.
7. Study of the transistor tester and determination of the parameters of the given transistors 8. Experiment using PLC Trainer Kits

Part B (IoT Lab)

1. To obtain the LED Blinking by BLYNK App using IOT ESP32 microcontroller
2. To Obtain the LED Pattern UART using IOT ESP32 microcontroller
3. To obtain the LED PWM using IOT ESP32 microcontroller
4. To obtain the Buzzer Multitone using IOT ESP32 microcontroller
5. To obtain the Buzzer PWM using IOT ESP32 microcontroller
6. To find the Temperature using SHTC Sensor using IOT ESP32 microcontroller
7. To obtain the humidity using SHTC RH sensor using IOT ESP32 microcontroller

Part C (Mini Project)

1. To study, analysis and investigation of Project and make a report using following steps: -
    a) Study of used component and sensors
    b) Study of used microcontroller/Microprocessor
    c) Study of software involve
    d) Constructive suggestion/modification and Application

Through Virtual Lab:

1. Measurement of low resistance Kelvin's double bridge.
2. To measure unknown capacitance of small capacitors by using Schering's bridge.
3. To measure unknown Inductance using Hay's bridge.
4. Measurement of capacitance by De Sauty Bridge.

Virtual Lab Link: http://vlabs.iitkgp.ernet.in/asnm/#
Available on: http://www.vlab.eo.in/broad-area-electronics-and-communications

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: Measure the unknown resistance, capacitance and inductance using LCR Bridge, Kelvin double bridge, Schering bridge, Hay's bridge, De-sauty bridge.

CO2: Practically demonstrate the different types of transducers like J-type, K-type, PT -100 and RTD.

CO3: Interpret frequency and phase difference from Lissajous figure.

CO4: Interpret hybrid parameters of transistor and demonstrate different transducer like LDR and LVDT.

CO5: Demonstrate Experiment using PLC Trainer Kits

Inter Departmental Course for Related Branch for
B.Tech2nd Year (effective from the session 2023-24)

Semester III														
Sr. No.	**Course Code**	**Course Title**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
			3	0	0								
1.	IOE035/ IOE045	Sensor & Instrumentation	3	1	0	20	10	30		70		100	4
2.	IOE038/ IOE048	Analog Electronics Circuits	3	1	0	20	10	30		70		100	4
3.	IOE039/ IOE049	Communication Engineering	3	1	0	20	10	30		70		100	4

IOE035/ IOE045	**Sensor and Instrumentation**	**3L:1T:0P**	**4 Credits**

Prerequisites: Physics, Electronics

Course Objectives:

1. To understand the concepts of measurement technology
2. To learn the various sensors used to measure various physical parameters.
3. To learn about the optical, pressure and temperature sensor
4. To understand the Intelligent Sensors and their applications

Unit	Topics	Chapters /reference	Lecture
1	**Sensors & Instrumentation:** Definition, Classification, Basics of Measurement, Error analysis, Static and dynamic characteristics of transducers, Performance measures of sensors, Sensor calibration techniques, Sensor Output Signal Types.	1[1] 1,2,3[2]	8
2	**Mechanical Transducers:** Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of temperature using Thermistor, Thermocouple & RTD, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.	5 [1] 6,10[2]	8
3	**Electrical Measuring Systems:** Measurement of Current, Voltage, Resistance, Impedance, Frequency Measurement, Measurement of Phase angle	3[1]	8
4	**Sensors-their applications:** Sensors for Manufacturing, Medical Diagnostics Sensors, Sensors for Environmental Monitoring, Aerospace Sensors	9[3]	8
5	**Intelligent Sensors**: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.	7[3]	8

Text Books:

[1] DVS Murthy, "Transducers and Instrumentation", PHI 2nd Edition
[2] D Patranabis, "Sensors and Transducers", PHI 2nd Edition

Reference Books:

[3] Arun K. Ghosh, "Introduction to measurements and Instrumentation", PHI, 4th Edition
[4] A.D. Helfrick and W.D. cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI
[5] Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition ,Oxford University Press

Course Outcomes - At the end of the course students will be able to:

CO1: Comprehend the basics of sensors and instrumentation
CO2: Employ commonly used sensors in industry for measurement of temperature, position, vibration sensor, flow and level.
CO3: Analyze the use of Electrical Measuring Systems
CO4: Understand various applications of Sensors in real world
CO5: Demonstrate the use of smart sensors

IOE038/ IOE048	Analog Electronics Circuits	**3L:1T:0P**	**4 Credits**

Prerequisites:- Basic idea of Fundamental of Electronics Engineering

Course Objectives:-

1. Define various BJT amplifier models systems.
2. Understand High frequency transistor models, frequency response systems.
3. Interpret various feedback topologies and Oscillators circuit Review
4. Analyze various parameters Current mirror: Basic topology and its variants.
5. Op-Amp applications: Review of topologies

Unit		**Chapter/ reference**	**Lectures**
I	**BJT amplifier models:** Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features.	Unit 5 [1] Unit 4-6[2]	8
II	**Feedback topologies:** Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, calculation with practical circuits, concept of stability, gain margin and phase margin.	Unit 10[3]	8
III	Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues **Oscillators:** Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.) and and non-sinusoidal oscillators	Unit 14[3] Unit 18 [2]	8
IV	**Differential amplifier:** Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR **Active filters:** Low pass, high pass, band pass and band stop, design guidelines.	Unit 9 [3]	8
V	**Op-Amp design:** design of gain stages and output stages, compensation. Op-Amp applications: precision rectifier, Schmitt trigger and its applications.	Unit 14 [2]	8

Text Books :-

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 6th Ed
2. ***Boylestad*** / Nashelsky, "***Electronic Devices*** and ***Circuit*** Theory", edition 7, prentice Hall

Reference book:

3. Rashid, "Microelectronic Circuits : Analysis and Design", Oxford University Press, 6th Ed

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand the characteristics transistors and FET as amplifiers.
2. Design and analyze Feedback design amplifiers.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand performance of differential amplifier.
5. Design OP-AMP based circuits.

IOE039/ IOE049	**Communication Engineering**	**3L:1T:0P**	**4 Credits**

Prerequisites:- Basic idea of signals, Engineering mathematics

Course Objectives:-

1. Define various fundamental aspects of the communication systems.
2. Understand various modulation & demodulation techniques used in communication systems.
3. Interpret various radio transmitter & receiver circuits and different types of noise in communication systems.
4. Analyze various parameters such as modulation index, channel capacity, transmission efficiency, S/N ratio etc. used in communication systems.

Unit		**Chapter/ reference**	**Lectures**
1.	**Introduction** Overview of communication system, communication channel, Need for modulation, Review of signals and system, frequency domain representation of signals, principles of amplitude modulation systems- DSB, SSB and VSB modulations.	1,2,3,4[1]	8
2.	**Continuous wave Modulation** Angle modulation representation of FM and PM signals, spectral characteristics of angle modulated signals. FM Modulators and Demodulators, FM Broadcasting	2 [2] 5 [1]	8
3.	**Random Processes and Noise** Review of probability and random process, Gaussian and white noise characteristics, noise in amplitude modulation systems, noise in frequency modulation systems, pre-emphasis and de-emphasis, threshold effect in angle modulation.	6 [1] 7 [1]	8
4.	**Pulse Modulation** Pulse modulation, sampling process, pulse amplitude and pulse code modulation (PCM), differential pulse code modulation. Delta modulation, noise considerations in PCM, time division multiplexing, digital multiplexers.	3[2]	8
5.	Digital modulation schemes- phase shift keying, frequency shift keying, quadrature amplitude modulation, continuous phase modulation and minimum shift keying.	6 [2] 10 [2]	8

Text Books :-

1. P Ramakrishna Rao., "Communication Systems", Mc Graw Hill Education
2. Haykin S., "Communications Systems," John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering," Pearson Education,2002.

Reference books :-

4. Taub H. and Schilling D.L., "Principles of Communication Systems," Tata McGraw Hill,2001.
5. Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering," John Wiley, 1965.
6. B.P. Lathi.,"Modern Digital and Analog Communication Systems" fourth edition.
7. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication," KluwerAcademic Publishers, 2004.

Course Outcomes: At the end of this course students will demonstrate the ability to:

CO1: Compare different analog modulation schemes for their efficiency andbandwidth.
CO2: Analyze the behavior of a communication system in presence of noise.
CO3: Investigate pulsed modulation system and analyze their system performance.
CO4: Investigate various multiplexing techniques.
CO5: Analyze different digital modulation schemes and compute the bit error performance.