B.Tech (ECE)

SEMESTER IV

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	104401	Analog Electronics and Integrated Circuits	3	0	0	3	70	30
2.	104402	Digital Circuits	3	0	0	3	70	30
3.	104403	Electromagnetic Field Theory	3	1	0	4	70	30
4.	104404	Analog Communication	3	0	0	3	70	30
5.	104405	Electronics Materials and Instrumentation	3	0	0	3	70	30
6.	104401P	Analog Electronics and Integrated Circuits Lab	0	0	2	1	30	20
7.	104402P	Digital Circuits Lab	0	0	2	1	30	20
8.	104404P	Analog Communication Lab	0	0	2	1	30	20
9.	104405P	Electronics Materials and Instrumentation Lab	0	0	2	1	30	20
10.	104406	NPTEL-I (Open Course)	12 Weeks			3	75	25
TOTAL						23	800	

Semester-IV

Course Code-104401 Analog Electronics and Integrated circuits 3 0 0 3

Unit- 1.0: Bipolar Junction transistor Amplifier Circuits: 9 hrs.
Small signal operation, hybrid and re model, frequency response analysis in different configurations, High frequency analysis of BJT. Miller effect, Analysis of Multistage amplifier, Frequency response of cascaded stages, Cascode amplifier, Darlington amplifier

Unit- 2.0: Field Effect transistor Amplifier Circuits: 7 hrs.
Small signal operation, frequency response analysis in different configurations High frequency model of the MOSFET, High frequency response of CS and CE amplifiers.

Unit- 3.0: Feedback Amplifiers and Oscillators: **10 hrs.**
Classification and representation of amplifiers, Feedback concept, General Characteristics of negative feedback amplifiers. Properties of feedback amplifier topologies, Oscillators: Sinusoidal oscillators, Barkhausen Criterion, Analysis and design of RC phase shift oscillator, Wien bridge oscillators. Resonant circuit oscillators, General form of oscillator circuit (Hartley & Colpitts), Crystal oscillators.

Unit- 4.0: Power Amplifier: 6 hrs.
Series-Fed Class A Amplifier, Transformer coupled Class A Amplifier, Class B amplifier Circuit and Operation, Amplifier Distortion, Push-Pull and Complementary Push-Pull Amplifiers, Power Transistor Heat Sinking, Class C and Class D Amplifier.

Unit- 5.0: Operational Amplifier: 4 hrs.
Ideal Operational Amplifier characteristics, General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, Frequency response of OP-Amp, Applications of OP-Amp- Inverting and Non-inverting Amplifier, V to I and I to V converter, Logarithmic amplifier, Antilogarithmic amplifier, Instrumentation amplifier

Unit- 6.0: Application of Op-Amp and special ICs: 6 hrs.
Comparator, Schmitt Trigger, 555 Timer, Multivibrators, Precision rectifier, First and Second Order Active Filters, Voltage Controlled Oscillator (IC 566), Phase Lock Loop (IC 565), LM 3805, IC8038

Text/ Reference:-

1. Roy Choudhury. D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 4th Edition, 2010.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2007.
3. Integrated devices & circuits by Millman & Halkias.
4. Electronic Devices & circuit theory by R. Boylestad.
5. Microelectronics by Sedra and Smith, Oxford University Press

Course Code-104402 Digital Circuits 3 0 0 3

Unit- 1.0: Number system: 4 hrs.
Binary Codes: BCD code, Excess-3 code, Gray-code. Complements: Signed magnitude, r's complement, (r-1)'s complement.

Unit- 2.0: Boolean laws and theorems: 6 hrs.
Logic Gate: Basic, Universal and Others, Truth TableLogic Functions, Conversion of Logic Functions into truth table and vice versa. SOP and POS forms of Representation, Canonical form, minterm and maxterms, Simplification of Logic Functions by Theorems and Karnaugh's Map, Don't Care Conditions.

Unit- 3.0: Combinational circuits: 9 hrs.
Adders: Half Adder, Full Adder, Parallel Adder, Carry Look ahead Adder. Subtractors: Half subtractor, Full subtractor. Multiplexer: 2x1, 4x1 and design of 8x1 multiplexer. Demultiplexer, Decoder, Encoder and comparator

Unit- 4.0: Sequential circuit: 9 hrs.
Latches, Flip-Flops SR, JK, D and T Flip Flop, Race around Condition, Master-Slave flip flop, Shift Registers, Counters- Synchronous and Asynchronous: Design of Ripple Counter.finite state machines.

Unit- 5.0: Data converter: 6 hrs.
Digital to Analog Converter, Binary-Weighted Resistors DAC, R-2R Ladder DAC, Analog to digital converters, Counter types ADC, Successive Approximation ADC, Dual Slope ADC, Flash ADC.

Unit- 6.0: Logic families & semiconductor memories: 8 hrs.
Characteristics of Digital ICs: Propagation delay, Power dissipation, Figure of Merit, Fan-out, Noise immunity, Wired-logic capability. Transistor-Transistor Logic, Emitter-Coupled Logic, MOS Logic, CMOS Logic, Transmission Gate, Comparison between logic families RAM, ROM, PLA, PAL; Circuit Implementation using ROM, PLA and PAL

Text/ Reference: -

1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.
3. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
4. A Anand Kumar Fundamental of digital circuits PHI 4th edition

Course Code-104403 Electromagnetic Field Theory 3 1 0 4

Unit- 1.0: Vector calculus and Coordinate system: 6 hrs.
Introduction to Vector Algebra, Coordinate Systems (rectangular, cylindrical, and spherical) and Transformation, Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence, and curl; integral theorems of vectors.

Unit- 2.0: Electrostatics: 8 hrs.
Coulomb's law, Gauss's law and its applications, Electric field intensity, Electrical field due to point charges, Line, Surface and Volume charge distributions, Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Poisson's and Laplace's equation, Applications (solution for some simple cases), Capacitance, Electrostatic energy, Conductor properties and Uniqueness Theorem.

Unit- 3.0: Magnetostatics: 7 hrs.
Biot-Savart law, Ampere's circuital law, Magnetic flux and magnetic flux density, Energy stored in magnetic field, Ampere's force law, Magnetic vector potential, Analogy between electric and magnetic field. Maxwell's equations in differential and integral form

Unit- 4.0: Maxwell's Equations and Time-Varying Field: 7 hrs.
Faraday's law, transformer and motional EMF, displacement current, Maxwell's equations in time static and time varying field, time harmonic field. Dielectric and Magnetic boundary condition.

Unit- 5.0: Electromagnetic Wave Propagation in Different Media: 8 hrs.
Uniform Plane Wave Propagation, Wave Propagation in Free Space, Dielectric and Conductor; Skin Effect; Wave Polarization, plane of incidence, Reflection of Plane wave (at normal and oblique) for conductor and dielectric, surface Impedance, Poynting Vector: Poynting Theorem, Instantaneous, Average and Complex Poynting Vector, Power Loss in Plane Conductor

Unit- 6.0: Transmission Lines: 6 hrs.
Introduction, Concept of distributed elements, Equations of voltage and current, standing waves and Reflection Coefficient, Lossless and low-loss transmission lines, Power transfer on a transmission line, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Text/Reference:-

1. Matthew N.O. Sadiku: "Elements of Engineering Electromagnetics" Oxford University Press.
2. Engineering Electromagnetics by William Hayt, TATA McGraw-Hill.
3. Narayana Rao, N: "Elements of Engineering Electromagnetics", Pearson Education.
4. Electromagnetics, JD Kraus, McGraw-Hill.

Course Code-104404 Analog Communication 3 0 0 3

Unit- 1.0: Introduction to Communication Systems: 4 hrs.

Basic components of communication systems; Types of communication: Analog vs. Digital; Bandwidth requirements and frequency spectrum and Modulation and its necessity.

Unit- 2.0: Amplitude Modulation (AM) Systems: 8 hrs.

Principles of amplitude modulation; AM, DSB-SC, SSB, and VSB modulation techniques; Generation and detection of AM and DSB; AM waveforms and frequency spectrum; Modulation index and power relations and AM transmitters and receivers.

Unit- 3.0: Angle Modulation: 10 hrs.

FM and PM, Transmission FM spectra, Carson 's rule, Narrow band, and wide band FM Generation of FM by Direct Methods. Indirect Generation of FM; The Armstrong Method, Direct Methods of Frequency Demodulation; Slope Detector, Foster Seely or Phase Discriminator, Indirect methods of FM Demodulation; FM Detector using PLL, Comparison of FM and PM

Unit- 4.0: Receivers: 8 hrs.

Tuned Radio Frequency (TRF) Receiver, Basic Elements of AM Super-heterodyne receiver; RF Amplifiers Characteristics Sensitivity, Selectivity, Image Frequency Rejection, Mixers Tracking and Alignment, Local Oscillator, IF Amplifier, AGC, AM Receiver using Transistors Communication Receiver. FM Receiver

Unit- 5.0: Noise in Communication Systems: 6 hrs.

Types of noise: thermal, shot, and flicker noise; Signal-to-noise ratio (SNR) and its impact on system performance; Noise figure and noise temperature and Noise in AM and FM systems Pre emphasis and de-emphasis

Unit- 6.0: Pulse Modulation Technique: 6 hrs.

Pulse Modulation techniques – Sampling Process, PAM, PWM and PPM concepts, Methods of generation and detection. Noise performance

Text/Reference:-

1. Electronic communication systems by George Kennedy.
2. Principle of communication systems by Taub and schilling.
3. B. P. Lathi and Z. Ding, "Modern Digital and Analog Communication Systems", 4th Ed., Oxford University Press, 2009.
4. J. G. Proakis, and M. Salehi, 'Fundamentals of Communication Systems', Fifteenth Impression, Pearson Education Inc., India, 2013.

Course Code-104405 Electronics Materials and Instrumentation 3 0 0 3

Unit- 1.0: Electronic Materials: 8 hrs.

Atomic structure and bonding in materials. Crystal structure of materials, Crystal systems, Unit cells and space lattices, Determination of structures of simple crystals by X-ray diffraction, Miller indices of planes and directions, Packing geometry in Metallic, Ionic and Covalent solids. Concept of amorphous, single and polycrystalline structures and their effect on properties of materials.Insulator, semiconductor, and conductor.

Unit- 2.0: Electronic Material Properties: 8 hrs.

Polarization, Dielectric constant at low frequency & high frequency, Dielectric loss, Piezoelectricity & Ferroelectricity, Origin of magnetism in metallic and ceramic materials, Para magnetism, Diamagnetism, Antiferromagnetism, Ferromagnetism, Ferrimagnetism, magnetic hysteresis, Influence of temperature on magnetic behavior, domains and Hysteresis. Superconductors, Meissner effect, Applications.

Unit- 3.0: Measurement and Error: 7 hrs.

Sensitivity, Resolution, Accuracy and Precision, Absolute and Relative types of errors, Statistical analysis, Probability of Limiting errors, Linearity. Instruments: Current and Resistance in instruments, Analog and Digital Multimeters, Measurement of time and Frequency – Digital Frequency Meter and applications.

Unit- 4.0: Impedance Measurement: 8 hrs.

Kelvin Bridge; Megger; Maxwell, Hay and Sheering Bridges. Q-meter; Noise and Interference reduction techniques in Measurement Systems, Wave Analyzer, Spectrum Analyzer, FFT Analyzer, Oscilloscopes: Pulse Measurements, Delayed Time Base, Analog Storage, Sampling and Digital Storage Oscilloscopes.

Unit- 5.0: Transducers: 8 hrs.

Classification and selection of Transducers, Introduction to Strain, Load, Force, Displacement, Velocity, Acceleration, Pressure and Temperature Measurements; Introduction to Smart sensors and MEMS.

Unit- 6.0: Introduction to Data Acquisition Systems (DAS): 3 hrs.

Block Diagram, Specifications and various components of DAS, applications of DAS in various fields

Text/Reference:-

1. Bell DA, “Electronic Instrumentation and Measurements,” Prentice Hall2.
2. Sawhney A.K., “Electrical and Electronic Measurements and Instrumentation,” Dhanpat Rai and Sons.
3. “Solid State Physics”, by Kittel, McGraw Hill.
4. “Principles of Electric Engineering Materials & Devices”, by S.O. Kasp, Mc- Graw Hill.
5. “Structure & properties of materials (VOL VI), Electronic Properties”, by Robert M. Rose, Lawrence A. Shepherd & John Wulf, Wiley Eastern Ltd.

Course Code-104401P Analog Electronics and Integrated circuits Lab 0 0 2 1

(Perform all Experiments)

List of Experiments:

1. Study of single stage RC coupled amplifier. Its frequency response and effect of emitter bypass capacitor.
2. (a) Design of a first order RC Low Pass filter circuit & observing its frequency response and time response.
   (b) Design of a first order RC high pass filter circuit & observing its frequency response and time response.
3. Study of class B push-pull amplifier
4. Study inverting amplifier, non-inverting amplifier and voltage follower using op amp IC741.
5. (a) To measure slew rate of Op-Amp, (b) To measure full-power & unity gain bandwidth of Op-Amp
6. Application to Op-Amp (a) adder, (b) subtractor, (c) integrator and differentiator using op-amp IC741and observe output waveform for different input waveform.
7. To study the performance of instrumentation amplifier using op-amp IC741.
8. To study RC phase-shift oscillators using op-amp IC741.
9. To study the Wien-bridge oscillators using op-amp IC741.
10. To study Schmitt trigger circuits using op-amp IC741

Course Code-104402P Digital Circuits Lab 0 0 2 1

(Perform all Experiments)

List of Experiments :

1. **To Implement Logic Gates – NAND, AND, NOR, EX-OR, EX-NOR** – Construct and test the fundamental logic gates using digital ICs and verify their truth tables by applying various input combinations.
2. **To Construct the Basic Gates Using Universal Gates** – Design and implement AND, OR, and NOT gates using only NAND and NOR gates and validate their functionality with truth table verification.
3. **To Verify the Truth Table of Half Adder and Full Adder** – Implement half adder and full adder circuits using logic gates, observe their outputs for different binary inputs, and confirm their addition properties.
4. **To Verify the Truth Table of Half and Full Subtractor** – Construct and test the half subtractor and full subtractor circuits, analyze their outputs for various input conditions, and verify their correctness against theoretical truth tables.
5. **To Convert Binary Numbers to Gray-Number Codes and Vice Versa** – Develop and test a combinational circuit that converts binary numbers to gray code and vice versa, ensuring correctness through truth table validation.
6. **To Verify the Truth Table of Multiplexer Using IC & Demultiplexer Using IC and Design Full Adder & Full Subtractor Using Multiplexer** – Demonstrate the working of multiplexer and demultiplexer ICs, verify their functionality with truth tables, and use multiplexers to design a full adder and full subtractor.
7. **To Convert a Given Octal Input to the Binary Output and to Study the LED Display Using 7-Segment Decoder/Driver** – Implement a logic circuit that converts octal numbers to binary and analyze the working of the decoder by displaying outputs on a 7-segment display.
8. **Truth Table Verification of Flip-Flops: (a) JK Master-Slave, (b) D-Type, (c) T-Type** – Construct and test different types of flip-flops, observe their state changes for various input conditions, and verify their characteristic equations.
9. **Design and Testing of Ring Counter/Johnson Counter** – Design, implement, and analyze the working of ring and Johnson counters, verify their sequence of outputs, and compare them with theoretical predictions.
10. **Realize the following shift registers using IC7474/IC 7495.**

(a)SISO (b) SIPO (c) PISO (d) PIPO

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Course Code-104404P Analog Communication Lab 0 0 2 1

(Perform all Experiments)

List of Experiments:

1. To study the function of Amplitude Modulation & Demodulation (under modulation, perfect modulation & over modulation) and calculate the modulation index.
2. To study the working of the Balanced Modulator and demodulator.
3. To generate SSB using phase method and detection of SSB signal using Synchronous detector.
4. To study the process of frequency modulation and demodulation and calculate the depth of modulation by varying the modulating voltage.
5. To verify the spectrum of AM and FM signals using spectrum analyzer.
6. To study the frequency response of Pre-Emphasis and De-Emphasis circuits.
7. To study the frequency division multiplexing and De multiplexing Techniques.
8. To study the Pulse amplitude modulation & demodulation Techniques.
9. To study the Pulse Width Modulation (PWM) and Demodulation Techniques.
10. To study the generation Pulse Position Modulation (PPM) and Demodulation.

Course Code-104405P Electronics Materials and Instrumentation Lab 0 0 2 1

(Perform any ten Experiments)

List of Experiments:

1. Measurement of the Hall voltage developed across the sample material and estimation of the Hall coefficient.
2. Calculate the carrier concentration of the sample material (n-type and p-type semiconductor).
3. Characteristics of LDR, Photodiode, and Phototransistor.
4. Study the phenomena of magnetic hysteresis of a material.
5. Calculate the retentivity, coercivity, and saturation magnetization of a material.
6. Measurement of the resistivity of a semiconductor at room temperature.
7. Verification of the temperature coefficient of resistance of a semiconductor and metal.
8. Measurement of an unknown Inductance of medium-Q coil using Maxwell Bridge.
9. Measurement of Frequency using Wein's Bridge.
10. Measurement of R, L, & C using RLC Bridge.
11. Measurement of Displacement using LVDT.
12. Measurement of Pressure using Strain Gauge.
13. Measurement of Temperature using RTD, Thermistor and Thermocouple.
14. Perform actuations using the Pneumatic Actuator Trainer.
15. Calibration of pressure instruments using dead weight pressure gauge tester.

Course Code-104406 NPTEL (Open Course) 12 Weeks (3 Credits)

NPTEL (Open Course) Guidelines:

NPTEL (Open Course) should be taken from the course other than core subjects of the branch.