THREE-YEAR (SIX SEMESTER) MULTIDISCIPLINARY UNDER GRADUATE COURSES OF STUDIES IN ELECTRONICS
Multidiscplinary Course (MDC)

FIRST YEAR : FIRST SEMESTER

Course Name: Fundamentals of Circuit Theory and Electronic Devices
[Credits: 4 (3Th + 1P)]

ELT-MD-CC-1-1-TH
Course Name: Fundamentals of Circuit Theory and Electronic Devices
[Credits: 3; Lecture Hours: 45]

UNIT-I [12 Hours]

Electric Circuit Elements: Resistance and Resistors: Types, Color Coding and Power Rating, Variable Resistors, Capacitance and Capacitors: Types, Color Coding and Voltage Rating, Inductance and Inductors: Types, Color Coding, Inductor Coils, Air-core and Iron-core Coils, Self-inductance and Mutual-inductance, Transformers.

Circuit Analysis: Concept of Voltage and Current Sources, Conservations of Flux Leakage associated with Inductors and Charge associated with Capacitors, Kirchhoff's Voltage Law, Kirchhoff's Current Law, Transformation of Voltage and Current Sources, Mesh Analysis and Node Analysis, Star-Delta Networks and Conversion.

DC Analysis: Transient Responses of Series RL and RC Circuits under DC Excitation.

AC Analysis: Responses of Circuit Parameters, Frequency Response of Series RL, RC and RLC Circuits under AC Excitation, Quality (Q) Facor of Inductor and Capacitor, Series and Parallel Resonance Circuits, Q-Factor.

Network Therems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, and Maximum Power Transfer Theorem.

UNIT-II [11 Hours]

Semiconductor Basics: Semiconductor Materials: Types and Properties, Concept of Energy Bands in Solids: Metal, Insulator and Semiconductor, Intrinsic and Extrinsic Semiconductors, P-Type and N-Type Semiconductors, Energy Band Diagram, Concept of: Effective Mass, Direct and Indirect Bandgap Semiconductors, Fermi Level, Density of States, Mechanism of Current Conduction in Semiconductors (Drift and Diffusion), Drift Velocity, Mobility, Resitivity, Conductivity, Hall Effect (No derivation).

Junction Diode and Its Applications: PN Junction: Wafer Level Structure, Energy Band Diagram, Depletion Layer, Diode Equation and I-V Characteristics, Ideal Diode, Static and Dynamic Resistance, Reverse Saturation Current, Zener and Avalanche Breakdown, Zener Diode, Zener Diode as Voltage Regulator, Rectifiers: Half Wave Rectifier, Full Wave Rectifiers (Center tapped and Bridge), Peak Inverse Voltage, Ripple Factor, Efficiency, Line Regulation, Load Regulation, Transformer Utilization Factor, Shunt Capacitor Filter, Concept of Bleeder Resistor.

UNIT-III [11 Hours]

Bipolar Junction Transistor: Wafer Level Structure, and Brief Manufacturing Techniques (Growth, Alloy or Fused, Diffusion, Epitaxy), Energy Band Diagram, Doping Profile, PNP and NPN Transistors, Common Base (CB), Common Emitter (CE) and Common Collector (CC) Configurations, Working Principle, Emitter (Injection) Efficiency, Base Transportation Factor, Current Components in BJT, Current Gains: α, β and γ, Input and Output Characteristics in CB, CE and CC Modes, Early Effect and Voltage, Leakage Currents.

Transistor Biasing: Need for Biasing and Bias Stabilization, Load Line and Q-Point, Stability and Stability Factor, Thermal Runaway, Fixed Bias, Collector to Base Bias, Voltage Divider Bias and Emitter Bias.

UNIT IV [11 Hours]

BJT Amplifiers: r_e-model and h-Parameter Equivalent Circuit of BJT, Small Signal Analysis of Single Stage CE Amplifier, Frequency Response, Input and Output Impedances, Current, Voltage and Power Gains, Concept of Class A, B, AB and C Amplifiers.

Field Effect Transistor: Junction FET, Formation of Channel and Operating Principle, Pinch Off and Saturation Voltages and Currents, Drain and Transfer Characteristics of N-Channel JFET, FET Parameters, Small Signal Equivalent Circuits of JFET in Common Source (CS), Common Drain (CD) Configurations, Voltage Gain, Input and Output Imedances of CS FET Amilifier, Normally-Off and Normally-On MESFET.

ELT-MD-CC-1-1-P

Course Name: Fundamentals of Circuit Theory and Electronic Devices Laboratory

[Credits: 1; Contact Hours: 30]

1. To Familiarize with Basic Electronic Components (R, C, L, Diodes, Transistors), Digital Multimeter, Function Generator and Oscilloscope.
2. Verification of (a) Thevenin's Theorem and (b) Norton's Theorem.
3. Verification of (a) Superposition Theorem and (b) Maximum Power Transfer Theorem.
4. Study of the I-V Characteristics of (a) P-N Junction Diode and (b) Zener Diode.
5. Study of (a) Half Wave Rrectifier and (b) Full Wave Rrectifier (FWR) without and with Capacitor Filter.
6. Study of Zener Diode as Voltage Regulator and its Load Regulation.
7. Study of the I-V Characteristics of the Common Emitter Configuration of BJT
8. Study of the I-V Characteristics of the Common Base Configuration of BJT
9. Study of the I-V Characteristics of JFET.

Reference Books:

• Nasar, Electric Circuits, Schaum's Solved Problems Series, Tata McGraw Hill.
• Nahvi and Edminister, Electric Circuits, Schaum's Outline Series, Tata McGraw Hill.
• Boylestad, Essentials of Circuit Analysis, Pearson.
• Chattopadhyay and Rakshit, Fundamentals of Electric Circuit Theory, S. Chand.
• Hyat, Kemmerly and Durbin, Engineering Circuit Analysis, Tata McGraw Hill.
• Sadiku, Musa and Alexander, Applied Circuit Analysis, Tata McGraw-Hill.

• Bel, Electric Circuits, Oxford.
• Kuo, Network Analysis and Synthesis, Wiley.
• DeCarlo and Lin, Linear Circuit Analysis, Oxford.
• Ghosh, Network Theory: Analysis and Synthesis, PHI.
• Smith and Alley, Electrical Circuits: An Introduction, Cambridge.
• Ryder, Network, Lines and Fields, Pearson.
• Boylestead and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
• Bell, Electronic Devices and Circuits, Oxford.
• Chattopadhyay and Rakshit, Electronics: Fundamentals And Applications, New Age.
• Sedra, Smith and Chandorkar, Microelectronic Circuits, Oxford.
• Millman and Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw Hill.
• Cathey, 2000 Solved Problems in Electronics, Schaum's Outline Series, Tata McGraw Hill.
• Mottershead, Electronic Devices and Circuits: An Introduction, PHI.
• Dutta, Semiconductor Devices and Circuits, Oxford.
• Rashid, Electronic Devices and Circuits, Cengage.

Practical:

1. Basic Electronics: A Text Lab Manual, Zbar, TMH
2. Laboratory Manual for Electronic Devices and Circuits, Bell, PHI
3. Advanced Practical Physics, Volume 2, B. Ghosh.

FIRST YEAR : SECOND SEMESTER

Course Name: Operational Amplifier and Digital Systems
[Credits: 4 (3Th + 1P)]

ELT-MD-CC-2-2-TH
Course Name: Operational Amplifier and Digital Systems
[Credits: 3; Lecture Hours: 45]

Unit I [11 Hours]

Operational Amplifiers: Characteristics of Ideal and Practical Op-Amp, Open and Closed Loop Configuration, Frequency Response, Concept of Offset Voltage and Current, Bias Current, CMRR, PSRR, Slew Rate.

Applications of Op-Amps: Inverting and Non-Inverting Amplifiers, Concept of Virtual Ground, Summing and Difference Amplifiers, Differentiator, Integrator, Multiplier and Divider, Logarithmic and Anti-logarithmic Amplifiers, Voltage to Current and Current to Voltage Converters, Comparator and Zero-Crossing Detector, Schmitt Trigger.

Unit II [12 Hours]

Number System and Codes: Weighted and Non-Weighted Codes, Decimal, Binary, Octal and Hexadecimal Number Systems, Base Conversions, 1's and 2's Complements, Representation of Signed and Unsigned Numbers, Binary Codes (BCD, 8-4-2-1, Excees-3, Gray Codes),

Alphanumeric Codes, ASCII, EBCDIC, Fixed and Floating Point Arithmetic, Binary and Hexadecimal Arithmetic, Addition, Subtraction by 2's Complement Method, BCD Addition, Parity Bits, Error Detecting and Correcting Code (Hamming).

Boolean Algebra and Logic Gates: Positive and Negative Logic, Basic Postulates and Fundamental Theorems of Boolean Algebra, De Morgan's Theorems, Logic Symbol and Truth Tables of Basic Logic Gates (AND, OR, NOT), Derived Logic Gates (NAND, NOR, XOR and XNOR), Universal Property of NOR and NAND gates.

Digital Logic Families: Characteristics of Logic Families (TTL and CMOS), Fan-in, Fan-out, Noise Immunity, Noise Margin, Power dissipation, Figure of Merit, Speed Power Product, Propagation Delay, Comparison of TTL and CMOS Families.

Combinational Logic Analysis: Standard Representation of Logic Functions (SOP and POS), Karnaugh Map Minimization (up to 4 Variables).

Unit III [11 Hours]

Combinational Circuits Design: Half and Full Adder, Half and Full Subtractor, 4-Bit Binary Adder and Subtractor, Multiplexers, Demultiplexers, Encoder, Decoder, Code Converters.

D-A and A-D Conversion: 4-Bit Binary Weighted and R-2R D-A Converter, Circuit and Working, Accuracy and Resolution, A-D Conversion Characteristics, Successive Approximation ADC. (Mention of relevant ICs for all).

Unit IV [11 Hours]

Sequential Circuits: Latches, Flip Flops (SR, JK, D and T), Truth Table, Excitation Table and Excitation Equation, Clocked (Level and Edge Triggered) Flip Flops, Preset and Clear Operations, Race Around Conditions in JK Flip Flop, Master-Slave JK Flip Flop.

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (up to 4 Bits).

Counters (4 bits): Ripple, Ring, Johnson, Synchronous, Asynchronous, Decade and Modulo-N Counters (Asynchronous only).

ELT-MD-CC-2-2-P

Course Name: Operational Amplifier and Digital Systems Laboratory

[Credits: 1; Contact Hours: 30]

1. To Design Inverting and Non-Inverting Amplifiers using Op-Amp (741/351) for DC Voltage of given Gain.
2. To Add two DC Voltages using Op-Amp in Inverting and Non-Inverting Mode.
3. To Design Differentiator and Integrator Circuit using Op-Amp (741/351).
4. To Design Comparator and Schmitt Trigger Circuit using OPAMP.
5. To Verify and Design AND, OR, NOT and XOR Gates using NAND Gates.
6. To Convert Boolean Expression into Logic Circuit and Design it using Logic Gate ICs.
7. To Design Half Adder and Full Adder.
8. To Design Half Subtractor and Full Subtractor.
9. To Design 4-Bit Binary Adder and Adder-Subtractor using Full Adder IC 7483.
10. To Design 4×1 Multiplexer using Logic Gates.

11. To Design RS, D and JK Master-Slave Flip Flops using NAND Gates.
12. Construction of 4-Bit Shift Registers (Serial and Parallel) using JK/D Type FF.
13. To Design Ripple Counter.

Reference Books:

• Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson.
• Coughlin and Driscoll, Operational Amplifiers and Linear Integrated Circuits, Pearson.
• Malvino, Electronic Principals, Tata McGraw-Hill.
• Kishore, Operational Amplifiers and Linear Integrated Circuits, Pearson.
• Bel, Operational Amplifiers and Linear Ics, Oxford.
• Jacob, Analog Integrated Circuits Applications, Pearson.
• Fiore, Op-Amps and Linear Integrated Circuits: Concepts and Applications, Cengage.
• Ganesh Babu, Linear Integrated Circuits and Applications, Scitech.
• Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw Hill.
• Flyod, Digital Fundamentals, Pearson.
• Raychaudhuri, Digital Circuits, Vol. 1&2, Platinum.
• Gothmann, Digital Electronics: An Introduction to Theory and Practice, PHI.
• Kumar, Fundamentals of Digital Circuits, PHI.
• Dueck, Digital Design, Cengage.
• Comer, Digital Logic and State Machine Design, Oxford.
• Salivahanan and Kumar, Digital Circuits and Design, Vikas.
• Fletcher, An Engineering Approach to Digital Design, Pearson.
• Wakerly, Digital Design: Principles and Practices, Pearson.

Practical:

4. Practical Physics, Rakshit and Chattopadhyay.
5. Advanced Practical Physics, Volume II, B. Ghosh, New Central Book Agency
6. Laboratory Manual for Electric Circuits, Bell.

Skill Enhancement Course (SEC)
Course Name: Circuit Simulation with PSPICE
[Credits: 4 (3Th + 1P)]

ELT-MD-SEC-TH
Course Name: Circuit Simulation with PSPICE
[Credits:3; Lecture Hours: 45]

UNIT I [12 Hours]

Introduction to PSpice Software: Introduction, Descriptions of Spice, Types of Spice, File Types, PSpice platform (PSpice A/D, PSpice Schematics, OrCAD Capture), Limitations of PSpice.

Circuit Descriptions: Input files, Element values, Nodes, Circuit elements, Sources, Types of analysis,
Output variables, PSpice output commands, Format of Circuit Files, Format of Output Files.