UNIVERSITY OF CALCUTTA

NotificationNo.CSR/18/2023

It is notified for information of all concerned that in terms of the provisions of Section 54 of the Calcutta University Act, 1979, (as amended), and, in exercise of her powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 17.07.2023 approved the syllabus of the under mentioned subjects semester wise Four-year (Honours & Honours with Research) /Three-year (Multidisciplinary) programme of U.G. courses of studies, as applicable under CCF,2022, under this University, as laid down in the accompanying pamphlet.

SL.NO.	NAME OF SUBJECTS
1.	ENVIRONMENTAL Science
2.	Physics
3.	French
4.	Sanskrit (Honours)
5.	Arabic
6.	Library & Information Studies
7.	Statistics
8.	Electronics
9.	Household Art (Minor/MDC)
10.	Microbiology (Revised syllabus After incorporating some amendments, in the syllabus Published in CSR/13/23, Dt.12/07/2023)
11.	Psychology (Revised syllabus After incorporating some amendments, in the syllabus Published in CSR/13/23, Dt.12/07/2023)
12.	Hindi (Revised syllabus After incorporating some amendments, in the syllabus Published in CSR/13/23, Dt.12/07/2023)
13.	B.B.A. (Honours syllabus After incorporating some amendments, in the syllabus Published in CSR/13/23, Dt.12/07/2023)

The above shall be effective from the academic session 2023-2024.

24.7.2023

Prof.(Dr.) Debasis Das

Registrar

SENATE HOUSE

KOLKATA-700 073

The 24th July, 2023

UNIVERSITY OF CALCUTTA

SYLLABUS

FOR

FOUR-YEAR (EIGHT SEMESTER)

and

THREE-YEAR (SIX SEMESTER)
MULTIDISCIPLINARY

UNDER GRADUATE COURSES OF STUDIES

IN

ELECTRONICS

UNDER CCF-2022

2023

FOUR-YEAR (EIGHT SEMESTER)
UNDER GRADUATE COURSES OF STUDIES
IN ELECTRONICS

FIRST YEAR : FIRST SEMESTER

Discipline Specific Core-1 (DSC-1)/Major-1
Course Name: Fundamentals of Circuit Theory and Electronic Devices
[Credits: 4 (3Th + 1P)]

ELT-H-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-H-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.

Skill Enhancement Course-1 (SEC-1)

Course Name: Introduction to Programming in Python
[Credits: 4 (3Th + 1P)]

ELT-H-SEC-1-1-TH
Course Name: Introduction to Programming in Python
[Credits:3; Lecture Hours: 45]

UNIT I [15 Hours]

Python Installation, PIP Package Manager, Concept of Installing Python in a Virtual Environment, Executing Python Source File from Command Line, Examples of Python IDEs and Code Editors.

Python Syntax, Code Indentation, Identifiers and Keywords, Variables, Strings, Literals, Data Types, type() Function, Type Casting, Operators (Arithmetic Operator, Relational Operator, Logical or Boolean Operator, Assignment, Operator, Ternary Operator, Bit Wise Operator) and Expressions, Operator Precedence and Associativity, Reading Input from and Printing Output to Console.

Brief Idea and Use of Python Libraries Like NumPy, SciPy, Matplotlib, Pandas and Skikit-learn.

UNIT II [15 Hours]

Python Strings: String Methods and Operations, Use of Escape Characters in String.

Python Collections: Lists, List Items, List Constructor, List Operations, Tuples, Tuple Items, Tuple Constructor, Tuple Operations, Sets, Set Items, Set Constructor, Set Operations, Dictionaries, Dictionary Items, Dictionary Constructor, Dictionary Operations.

Branching and Looping Constructs, if, if-else, if-elif Statements, while loop and for loop, Continue and Break Statements, Range Function, Pass Statement, Nested Loops.

User Defined Functions, def Keyword, Calling a Function, Function Arguments, Arbitrary Arguments, Keyword Arguments, Return Statement, Recursive Functions., built-in Functions: Built-in Math Functions in Python.

UNIT III [15 Hours]

Python Modules, Creating and Importing Modules, Built-in Modules, Datetime Module.

File I/O: Reading from, writing to, creating and deleting a file in Python.

OOP Concepts in Python: Creating Classes and Objects, init_() Function, Concept of Inheritance, Parent and Child Classes, super() Method, Concept of Polymorphism.

Exception Handling in Python: try, except, else and finally Blocks, Raising an Exception.

ELT-H-SEC-1-1-P

Course Name: Introduction to Programming in Python Laboratory

[Credits: 1; Contact Hours: 30]

1. Generate and print Fibonacci Numbers, starting from 0 to N (the number N being read from the keyboard). Also calculate and print the number of elements in the series.
2. Generate and print Prime numbers up to an Integer N (N being read from the keyboard). Also obtain and print the sum of these numbers.
3. Find the Highest Common Factor of two Integer numbers read from the keyboard. Print the result.
4. Calculate and print the Factorial of a given number read from the keyboard.
5. Find and print all the two real roots of a Quadratic equation Ax2 + Bx + C = 0 (the coefficients A, B and C are to be read from the keyboard) using the pertinent formula. Print a relevant message if an exception occurs.
6. Calculate and print the values of sin(x) and cos(x) using their respective Power Series representations. Also compare the values with those obtained using the corresponding Math library functions in Python.
7. Read in elements of a List of integer numbers from the keyboard. Find and print all the numbers in the list which are less than a given number N (N to be read from the keyboard).
8. Read strings as elements of a List from the keyboard. Sort the list. Change an item, add an item, and remove an item from the list. Print the list before sorting, after sorting, and also after making each change. Repeat the problem with integers instead of strings.
9. Create a Tuple constructor with strings and integers as items. The items are to be read from the keyboard. Unpack the items from the tuple to corresponding variables. Print the value of the variables.

10. Create one or more sets of items whose values are read from the keyboard. Make use of Set related methods copy(), difference(), difference_update(), intersection(), intersection_update(), union(), update(). Print the set(s) before and after invoking the methods.
11. Create a dictionary where the keys are numbers between 1 and N (keys and N to be read from the keyboard) and the values are square of keys. Copy the dictionary to another using the copy() and dict() methods. Print both the dictionaries.
12. Program making using of inheritance and polymorphism in Python.

Reference Books:

1. Think Python, Allen Downey, O'Reilly.
2. Introduction to Problem Solving with Python, E. Balaguruswamy, TMH.
3. Learning Python, Mark Lutz, O'Reilly.
4. Python Programming for the Absolute Beginner, Michael Dawson, Cengage Learning.
5. Introduction to Computation and Programming Using Python, John V. Guttag, MIT Press.
6. Scientific Computing in Python, Abhijit Kar Gupta, Techno World.

FIRST YEAR : SECOND SEMESTER

Discipline Specific Core-2 (DSC-2)/Major-2
Course Name: Operational Amplifier and Digital Systems
[Credits: 4 (3Th + 1P)]

ELT-H-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-H-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:

1. Practical Physics, Rakshit and Chattopadhyay.
2. Advanced Practical Physics, Volume II, B. Ghosh, New Central Book Agency
3. Laboratory Manual for Electric Circuits, Bell.

Skill Enhancement Course-2 (SEC-2)
Course Name: Aritificial Intelligence (AI) for Everyone

Interdiscplinary Course (IDC)

Course Name: Fundamentals of Electronics
[Credits: 3 (2Th + 1Tu); Lecture Hours: 30 (Th) + 15 (Tu)]

ELT-IDC-TH
Course Name: Fundamentals of Electronics
[Credits: 2; Lecture Hours: 30]

Unit-I [9 Hours]

Basic Circuit Components: Circuit Elements: Resistors, Inductors, Capacitors, Transformers, concept of voltage and current sources, Kirchhoff's current and voltage laws, concept of impedance, equivalent impedance of series and parallel combinations of R, L and C.

Operational Amplifiers and Its Applications: Op-Amp and its Characteristics (Ideal and practical), Open and Closed Loop Configuration, Concept of virtual ground, Inverting, Non-Inverting, Summing and Difference Amplifiers.

Unit-II [11 Hours]

Semiconductor Devices and Circuits: Intrinsic and Extrinsic Semiconductors, Direct and Indirect Bandgap Semiconductors, Basic Concept of P-N Junction, P-N Junction Diode, Zener Diode, Solar Cell, LED and their I-V Characteristics, Use of Diode as Half-Wave and Full-Wave (Center Tapped) Rectifier.

Bipolar Junction Transistors (BJT): NPN **and PNP Transistors, E**nergy Band Diagram, Working Principle of Transistor as Amplifier and Switch, CE, CB, CC Configurations, Input and Output Characteristics of NPN Transistor in CB and CE modes, Cut-off, Active and Saturation Regions, Current Components in Active Mode, Need for Biasing and Bias Stability, Operating (Q) Point, Small Signal h-Parameter Model of CE Transistor.

Field Effect Transistor: MOSFET Structure, Depletion and Enhancement Modes, Complimentary MOS (CMOS).

Unit-III [10 Hours]

Digital Logic Circuits: Number Systems (Binary, Decimal, Hexadecimal), Addition and Subtraction (using 1's and 2's complement method) of Binary Numbers, 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, Karnaugh Map Simplification (up to 4 Variables), Half-Adder and Full-Adder Circuits, Multiplexer, de-Multiplexer, SR, JK, D and T Flip Flops (Truth Table Only).

Electronic Communication: Introduction to Communication, Need for Modulation, Concept of AM and FM (Qualitative Discussions, No Derivations).

Reference Books:

• Boylestad, Essentials of Circuit Analysis, Pearson.
• Chattopadhyay and Rakshit, Fundamentals of Electric Circuit Theory, S. Chand.
• Sadiku, Musa and Alexander, Applied Circuit Analysis, Tata McGraw-Hill.
• Boylestead and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
• Bell, Electronic Devices and Circuits, Oxford.
• Chattopadhyay and Rakshit, Electronics: Fundamentals And Applications, New Age.
• Rashid, Electronic Devices and Circuits, Cengage.
• Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson.
• Coughlin and Driscoll, Operational Amplifiers and Linear Integrated Circuits, Pearson.
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• Kishore, Operational Amplifiers and Linear Integrated Circuits, Pearson.
• Jacob, Analog Integrated Circuits Applications, Pearson.
• 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.
• Comer, Digital Logic and State Machine Design, Oxford.
• Salivahanan and Kumar, Digital Circuits and Design, Vikas.

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.

DC Operation and Circuit Analysis: Modelling of elements, Operating temperature, Independent DC Sources, Dependent Sources, DC Output variables, Passive Devices, Component names, Ohm's Law, Kirchhoff's Laws, Capacitors in DC circuits , Inductors in DC circuits, Types of Output **(.PRINT, .PLOT, .PROBE, .WIDTH**) statements and significances, Types of DC analysis **(.OP, .TF, .DC, .PARAM)** commands and their uses.

UNIT II [15 Hours]

Transient Analysis: Capacitors and Inductors, Modelling of Transient Sources (Exponential Source, Pulse Source, Piecewise Linear Source, Sinusoidal Source), Independent voltage Source, Independent Current Source, Transient response (.IC, .TRAN) commands and their uses.

AC Circuit Analysis: AC Output variables, Independent AC Sources, AC analysis, Magnetic elements.

Semiconductor Diodes: Diode element description, Diode Model description, Diode Parameters, Zener Diode Modelling, Diode Characteristics (Forward Bias, Reverse Bias, and Breakdown Region), DC analysis and Small Signal AC analysis of diode circuits, Half -Wave Rectifier Circuit.

UNIT III [18 Hours]

Bipolar Junction Transistors: BJT Element Description, BJT Model Description, BJT Statements, BJT Parameters, NPN Transistor operation, Analysis of Transistor circuits at DC, Different modes of Operation of Transistors, Small- Signal Model of BJT Amplifiers, DC Bias Sensitivity Analysis (Sensitivity to Component Variation and Temperature Variation).

Field Effect Transistors: Introduction to MOSFETs, MOSFET Parameters, MOSFET Element Description, MOSFET Model Description, Enhancement Mode N-Channel MOSFET Circuit, I-V Characteristics of MOSFET, Analysis of MOSFET Circuits at DC (Enhancement Mode and Depletion Mode, N-Channel and P- Channel).

ELT-MD-SEC-P

Course Name: Circuit Simulation with PSPICE Laboratory

[Credits: 1; Contact Hours: 30]

1. Verification of Kirchhoff's Voltage Law and Current Law.
2. Mesh and Node Analysis of Circuits using DC Sources.
3. Transient Analysis of RC, RL Circuits using Step Input.
4. AC Analysis of Series and Parallel RLC Circuits using Sinusoidal Input.
5. I-V Characteristics of P-N Junction Diode Operated in Forward Biased Mode.
6. I-V Characteristics of Zener Diode Operated in Reverse Biased Mode.
7. Input and Output Characteristics of NPN Transistor.
8. Analysis of BJT CE Amplifier.
9. Analysis of the I-V Characteristics of Enhancement Mode N-Channel MOSFET.
10. Analysis of the I-V Characteristics of Depletion Mode N-Channel MOSFET.

Reference Books:

1. SPICE: A Guide to Circuit Simulation & Analysis using PSPICE, Paul. W. Tuinenga.
2. SPICE, Gordon. W. Roberts and Adel. S. Sedra.
3. Introduction to PSPICE Using ORCAD For Circuits and Electronics, Muhammad. H. Rashid.
4. Analog Design and Simulation using OrCAD Capture and PSPICE, Dennis Fitzpatrick.