VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN ELECTRONICS

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN ELECTRONICS
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	**ELCHMJ101**	**T: Introduction to Electronics** **P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**ELCSEC01**	**P: Introduction to Programming in Python**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC01**	Communicative English -1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC01**	Multidisciplinary Course -1 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC01**	ENVS (***common for all programmes***)	**4**	**2-0-2**	**50**	**50**	**100**
			Minor (Disc.-I)	**ELCMI01**	**T: Analog Circuits *(To be taken by students of other Disciplines)*** **P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
					Semester-I Total	**20**				**400**
		II	**SEMESTER-II**							
			Major-2	**ELCHMJ102**	**T: Fundamentals of Analog & digital Circuits** **P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**ELCSEC02**	**P: Mobile repairing and Programming**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC02**	MIL-1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC02**	Multi Disciplinary Course-02 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC02**	Value Added Course-02 (***to be chosen from the list***)	**4**	**4-0-0**	**10**	**40**	**50**
			Minor (Disc.-II)	**ELCMI02**	**T: Digital Circuits *(To be taken by students of other Disciplines)*** **P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			Summer Intern.	**CS**	Community Service	**4**	**0-0-4**	**-**	**-**	**50**
					Semester-II Total	**24**				**400**
					TOTAL of YEAR-1	**44**				**800**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

MAJOR (MJ)

MJ-1: Introduction to Electronics **Credits 04 (Full Marks: 75)**

MJ-1T: Introduction to Electronics (Theory) **Credits 03**

Course contents:

Basic Circuit Concepts: Circuit elements-different types of resistors, inductors and capacitors–identification and classification based on construction. Ideal and practical voltage and current sources. Dependent sources.

Network Theorems: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Principal of Duality, Star-Delta Conversion (Concept only).

Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Compensation Theorem, Tellegen's Theorem, Bisection Theorem, Millman's Theorem, Maximum Power Transfer Theorem.

P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism.

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). MOS Capacitor.

Power Devices: UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications. High Electron Mobility Transistor (HEMT).

Special semiconductor devices: Tunnel diode, varactor diode, LED, LCD and solar cell: circuit symbol, construction, operation characteristics and applications, 7-segment display, concept of common anode and common cathode types.

MJ-1P: Introduction to Electronics (Practical) **Credits 01**

Course contents:

1. Measurement of Amplitude, Frequency & Phase difference using CRO.
2. Verification of Kirchoff's Law.
3. Verification of Norton's theorem.
4. Verification of Thevenin's Theorem.
5. Verification of Superposition Theorem.
6. Verification of the Maximum Power Transfer Theorem.
7. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
8. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i, r_o, β.
9. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α.
10. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, ri, r_o.
11. Study of the I-V Characteristics of JFET.

Reference Books:

1. S.A.Nasar, Electric Circuits, Schaum' soutline series, Tata McGrawHill (2004)
2. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
3. W.H.Hayt, J.E.Kemmerly ,S.M.Durbin, Engineering Circuit Analysis, Tata McGrawHill (2005)
4. Alexander and M.Sadiku, Fundamentals of Electric Circuits, McGrawHill (2008)
5. ABruce Carlson ,Circuits, Cengage Learning
6. Kuo Network Analysis and Synthesis, Wiley India
7. Dorf, Introduction to Electric Circuits, Wiley India
8. Decarlo Lin, Linear Circuit Analysis, Oxford
9. Ghosh, Network Theory: Analysis and Synthesis, PHI
10. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
11. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
12. Dennis Le Croissette, Transistors, Pearson Education (1989)
13. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
14. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
15. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

MJ-2: Fundamentals of Analog & digital Circuits **Credits 04 (Full Marks: 75)**

MJ-2T: Fundamentals of Analog & digital Circuits (Theory) **Credits 03**

Course contents:

Diode Circuits: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Filters: types, circuit diagram and explanation ofshunt capacitor filter with waveforms.

Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Bipolar Junction Transistor: Review of CE, CB Characteristics and regions of operation. Hybrid parameters. Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with RE, collector to base bias, voltage divider bias and emitter bias

Transistor as a switch, circuit and working**,** Darlington pair and its applications.

BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RCcoupled).

Feedback Amplifiers: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances . Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator andHartley oscillator.

Op-Amp: Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, Open and closed loop configuration, Frequency Response, CMRR, Slew Rate, supply voltage rejection ratio and concept of Virtual Ground.

Applications of op-amps: Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative Study). Inverting and non- inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector.

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code. Gray Codes, Code converter.

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates.

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor. BCD adder.

MJ-2P: Fundamentals of Analog & digital Circuits (Practical) Credits 01

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of Zener diode as voltage regulator, load regulation and Line regulation.
3. Designing of a Single Stage CE amplifier.
4. Study of Fixed Bias, Voltage divider and Collector-to-Base bias for transistor. Draw the load line and find out Q points.
5. Study of the Colpitt Oscillator and Hartley Oscillators.
6. Study of op-amp characteristics: CMRR and Slew rate.
7. To design and study inverting/Non-inverting amplifier using Op-amp: Frequency and linearity Characteristics.
8. To study the zero-crossing detector and comparator
9. Designing of analog adder and subtractor circuit.
10. To verify and design AND, OR, NOT and XOR gates using NAND gates.
11. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
12. Design a Half adder, Full Adder, BCD adder and Full Subtractor.
13. Design a 4 X 1 Multiplexer using gates.
14. Design and implement 4:1 multiplexer. Study of IC 74153, 74157
15. Design and implement 1:4 demultiplexer. Study of IC 74139
16. Implement the given expression using IC 74151 8:1 multiplexer
17. Implement the given expression using IC 74138 3:8 decoder.

Reference Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
8. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation.
9. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
10. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, PearsonEducation (2001)
11. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
12. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
13. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)
14. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition).

15. Kumar, A. Anand. Fundamentals of Digital Circuits 2Nd Ed. PHI Learning Pvt. Ltd., 2009
16. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994).
17. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall ofIndia(2000).
18. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

MINOR (MI)

MI – 1: Analog Circuits **Credits 04 (Full Marks: 75)**

MI – 1T: Analog Circuits (Theory) **Credits 03**

Course contents:

Diode Circuits: Piece-wise linear characteristics of diode, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers–DC power supply, Regulation, Filters.

Circuits using Bipolar Junction Transistor: Review of CE, CB Characteristics and regions of operation. Hybrid parameters model Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor. Transistor as a switch; Types of Amplifier, BJT in an amplifier circuit: Voltage and Power amplifier, Classes of amplifiers, BJT amplifiers.

Op-Amp: Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, Open and closed loop configuration, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.

Applications of Op-Amps: Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative Study). Inverting and non- inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector.

Feedback Amplifiers: Concept of feedback, negative and positive feedback, Types of feedback circuits Barkhausen criteria for oscillations, Oscillators; Regulated power supply: series and shunt (using BJT)

JFET–Types - p-channel and n-channel, working and I-V characteristics - n-channel JFET, parameters and their relationships, Comparison of BJT and JFET.

MOSFET Circuits: Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits.
Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.

MI – 1P: Analog Circuits Lab (Practical) **Credits 01**

Course Outline

1. Study of the forward and reverse I-V Characteristics of a Diode.
2. Study of the input and output Characteristics of the of BJT .
3. Study of the I-V Characteristics of JFET.
4. Study of the half wave rectifier and Full wave rectifier.
5. Study of voltage regulator using Zener diode.
6. Designing of a Single Stage CE amplifier.

7. Designing of an amplifier of given gain for an inverting and non-inverting
    a. configuration using an op-amp.
8. Study of the zero-crossing detector and comparator using OP-AMP.
9. Designing of analog adder and subtractor circuit.
10. Designing of an integrator using op-amp for a given specification and study its frequency
    a. response.
11. Designing of a differentiator using op-amp for a given specification and study its frequency
    a. response.
12. Study of a differential amplifier circuit using OP-AMP.

Reference Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky,9thEdition, 2013, PHI
2. Electronic Devices, David A Bell, Reston Publishing Company
3. D.L.Schilling and C.Belove, Electronic Circuits :Discrete and Integrated, Tata McGraw Hill (2002)
4. DonaldA.Neamen, Electronic Circuit Analysis and Design, Tata McGrawHill (2002)
5. J.Millman and C.C.Halkias, Integrated Electronics, TataMcGraw Hill(2001)
6. J.J.Cathey,2000
7. Solved Problems in Electronics, Schaum' soutline Series, TataMcGraw Hill (1991)
8. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation
9. Sedra Smith, Microelectronic Circuits, 6/E Oxford
10. Bogart Electronic Devices and Circuits,6ePearson

MI-2: Digital Circuits — Credits 04 (Full Marks: 75)

MI-2T: Digital Circuits (Theory) — Credits 03

Course contents:

Number Systems and Boolean algebra

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1'sand2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes, Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families.

Combinational Logic

Combinational logic analysis and design: Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)

Sequential Logic

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

MI-2: Digital Circuits (Practical) Credits 01

Course Outline:

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder Half and Full Subtractor,.
4. Design of a decoder / Multiplexer circuit using gates.
5. Design a seven segment display driver.
6. Boolean Function implementation using Decoder and Multiplexer.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

Reference Books

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L.Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W.H.Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
4. R.L.Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw-Hill (1994)

SKILL ENHANCEMENT COURSE (SEC)

SEC 1: Introduction to Programming in Python **Credits 03**

SEC1P: Introduction to Programming in Python **Full Marks: 50**

Course Outline:

1. 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.
2. 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 Outputto Console.
3. Brief Idea and Use of Python Libraries Like NumPy, SciPy, Matplotlib, Pandas and Skikit- learn.
4. Python Strings: String Methods and Operations, Use of Escape Characters in String.
5. 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.
6. 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.
7. 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.
8. 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.
9. OOP Concepts in Python: Creating Classes and Objects, init_() Function, Concept of Inheritance, Parent and Child Classes, super() Method, Concept of Polymorphism.
10. Exception Handling in Python: try, except, else and finally Blocks, Raising an Exception.

Note: The computer programs/ codes in Python are required to be developed based on the above syllabus by the students in the computer Laboratory.

Suggested Readings:

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.

SEC 2: Mobile repairing and Programming **Credits 03**

SEC 2P: Mobile repairing and Programming **Full Marks: 50**

Course Outline:

1. Introduction to mobile phones, Generations of mobile phones, FHSS networks, GSM, Spread spectrum, CDMA, TDMA & Basic electronics components.
2. Handset Specific operating systems, Fundamentals Ideas, Handset features & applications, working principle of mobile handset & Components used in mobile handsets.
3. Tools & equipment used for repairing & maintenance of mobile handsets, types of power supply & batteries, boosting a battery, Troubleshooting basics.
4. Network problems, Power failure (dead), Mobile phone hardware troubleshooting (water damage, hanging, charging & keypad problems), Handsets assembly & disassembly, Soldering & desoldering & SMD rework station.
5. Installation of software, Flashing, PC based diagnostic tools, mobile sets formatting, use of secret codes.
6. Mobile softwares, Data cable, Card reader, Mobile display, Remove/replace Component & Mobile phone hardware troubleshooting

Suggested Readings:

1. Mobile phones and Tablets repairs: by Chukky Oparandu.
2. A First Course in Mobile Phone Repairing by Orval Peck