Vidyasagar University

Midnapore-721102, West Bengal

The syllabus for M.Sc. in Electronics

With Effect from 2025-26

Preamble

Electronics is a modern subject of learning. Phenomenological changes are happening in the society with the advancement of electronics. It is imperative to have skilled manpower to accelerate the progress in our society. In this direction, M.Sc. in Electronics course at Vidyasagar University is designed to impart basic as well as advance knowledge to the students for equipping themselves in the arena of electronics.

The M.Sc. in Electronics course was initiated at Vidyasagar University in the year 2001 and later on a department of Electronics was established in the year 2004. The departmental faculty members are qualified and experienced, and are dedicated to serve the students. They are active researcher in the fields like Materials science, Optoelectronics, Microwave engineering, and Semiconductor devices. Technical and non teaching staff members are also present to serve the students

The department offers two degree courses: ***M.Sc. in Electronics*** and ***Ph.D. in Electronics***, and one short-term course - ***Electronics and E-Waste Management***. The M.Sc. in Electronics curriculum has been designed based on Choice Bases Credit System (CBCS) with the contents of modern technological aspects of electronics. It is regularly updated to impart contemporary knowledge to the students in the field of electronics. The curriculum is framed up with the courses like Materials science, Semiconductor devices, Optoelectronics, VLSI design and technology, Microwave engineering etc. The Students get on-hand exposure in technologically modern laboratories like Signal processing lab, Microprocessor and microcontroller lab, Communication lab, VLSI lab, Digital lab and Circuit design lab. In the syllabus there is also a scope to transfer credit from MOOCS courses. The final semester students may opt either for Industrial training or Project work. The syllabus also complies with all India competitive examinations like NET, GATE, SET etc.

The students are getting smart class room teaching regularly. Apart from the regular classes to the students, remedial classes are arranged for the weaker students. Coaching classes are also provided for NET, SET, GATE examinations. Special lectures, Invited talks, Seminars are arranged for the students regularly in the department.

Programme/Learning Outcome (P/LO)

After completion the M.Sc. in Electronics course, the students will be able to:

PO1: Advanced Theoretical Knowledge: Acquire strong mathematical foundation, computational skills with Python, knowledge for analog and digital circuits, electronic materials, semiconductor devices, network analysis and synthesis, control systems and instrumentation, electronic and optical communications, electromagnetism and antenna, VLSI design and technology, digital signal processing and microprocessor and microcontroller.

PO2: Practical Skill Development: Confident to work independently in circuit design lab, digital lab, microprocessor and microcontroller lab, communication lab and VLSI design lab.

PO3: Research Skill Development: Learn to identify and formulate a research problem, literature review, scientific methodology, inference drawing, report writing and public presentation.

PO4: Industrial Exposure: Exposure to industrial atmosphere and to work therein with a real problem.

PO5: Ethics and Knowledge Systems: Learn ethical principles, professional ethics, responsibilities, engineering practice norms and Indian Knowledge systems.

PO6: Team work and Collaboration: Train up for individual and teamwork.

PO7: Communication Skill: Development of communication Skill for doing work at different research organizations, Government and multi-national sectors.

PO8: Interdisciplinary Integration: Integrate mathematical knowledge with other scientific and engineering domains, promoting interdisciplinary problem-solving.

PO9: Lifelong Learning: Engage in lifelong learning to stay updated with emerging areas in Electronics, Data communication, IOT & machine learning, and scientific research.

PO10: Employability and Entrepreneurship: Demonstrate employability and entrepreneurship skills by applying theoritical knowledge in teaching, research, industry, and innovation.

Programme Specific Outcomes (PSOs)

The M.Sc. In Electronics course will help to develop skilled scientific manpower having comprehensive knowledge on electronics with an understanding of technological developments and applications of the subject. After completion of the course, a student achieves:

PSO1: State-of-the-art knowledge about various theoretical and experimental techniques that are used within the scope of this subject.

PSO2: A comprehensive knowledge in the areas of electronic materials, analog electronics, digital electronics, computer programming, electronic communications, VLSI design and technology, digital signal processing, electronic devices, computer networks, microprocessor and microcontroller etc. and acquires good theoretical and practical insight in that fields.

PS03: Ability to demonstrate practical skills in the use of tools, technologies and methods related to electronics, and apply the scientific techniques in the design and execution of experiments.

PSO4: Working on a chosen specialized area of electronics in his/her master's project and/or industrial training develops an ability to carry out a scientific work independently.

PSO5: Skills to compete in national/international level examinations such as NET/SET/GATE etc., and can pursue a career in higher studies.

PSO6: Confident to do work at various research institutes, public and private organizations.

COURSE STRUCTURE OF M.Sc. IN ELECTRONICS

Semester	COURSE NO.		COURSE TITLES	Full Marks	No. of Lectures (hours)	CREDIT (Lecture – Tutorial - Practical)
I	ELC 101	DSC 1	Analog Circuits &Systems (Theory) Analog Circuits &Systems (Practical)	25 25	40	2(2-0-0) 2 (0-0-2)
	ELC 102	DSC 2	Digital System Design (Theory) Digital System Design (Practical)	25 25	40	2(2-0-0) 2 (0-0-2)
	ELC 103	DSC 3	Research Methodology(Theory) Research Methodology (Practical)	25 25	40	2(2-0-0) 2 (0-0-2)
	ELC 104	DSC 4	Modern Communication & Network Theory(Theory)	50	40	4(4-0-0)
	ELC 105	DSC 5	Microprocessor(Theory)	25	20	2(2-0-0)
	ELC 106	DSC 6	Python (Practical)	25	20	2 (0-0-2)
	ELC 107	IKS	Indian Knowledge System	25	20	2(2-0-0)
			Vidyasagar : Life and Philosophy	Compulsory non-credit Course		
			TOTAL	275		22
II	ELC 201	DSC 7	Semiconductor Device (Theory) Semiconductor Device (Practical)	25 25	40	2(2-0-0) 2 (0-0-2)
	ELC 202	DSC8	Signal and Systems (Theory)	25	20	2(2-0-0)
	ELC 203	DSC 9	E. M. Theory & Numerical Analysis (Theory)	50	40	4(4-0-0)
	ELC 204	DSC 10	Electronic Material & Applied Optics & Photonics (Theory)	50	40	4(4-0-0)
	ELC 205	DSC 11	Control System & Computer Network (Theory)	50	40	4(4-0-0)
	ELC 206	DSC 12	Microprocessor (Practical)	25	20	2 (0-0-2)
	ELC 207		Field Visit/ Industrial Visit	25		2(0-0-2)
			TOTAL	275		22
III	ELC 301	DSC 13	VLSI Technology (Theory) VLSI Technology (Practical)	25 25	40	2(2-0-0) 2(0-0-2)
	ELC 302	DSC 14	Microwave Technology (Theory)	25	20	2(2-0-0)
	ELC 303	DSC 15	Communication (Practical)	25	20	2(0-0-2)

	ELC 304	DSE 1	Bio- Medical Instrumentation OR Power and Industrial Electronics OR RF and Antenna Design	50	40	4(4-0-0)
	ELC 305	DSE 2	E –Waste & Renewable Energy OR Quantum Electronics OR Network Security and Cryptography Or Rader Signal Processing	50	40	4(4-0-0)
	ELC 306	MOOC	MOOCs from SWAYAM	50		4(4-0-0)
	ELC 307		Social Service / Community Engagement	25		2(0-0-2)
	TOTAL			275		22
IV	ELC 401	DSE 3	Optimization, machine learning and AI OR Electronic and Nano material OR Satellite, Wireless and Cellular Communication	50	40	4(4-0-0)
	ELC 402	DSE 4	System Design through Verilog OR Introduction to IOT OR Optical Fiber Communication	50	80	4(4-0-0)
	ELC 403		Research Project/Dissertation	100		8
	ELC 404		Internship/ Applied Field and Industry Project/ Start Up proposal and Practice	50		4
	ELC 405		IPR/ Hardware Maintenance	25		2(0-0-2)
	TOTAL			275		22

Full Marks : 50 = END SEMESTER EXAMINATION (40) + INTERNAL ASSESSMENT (10)

25 = END SEMESTER EXAMINATION (20) + INTERNAL ASSESSMENT (5)

ELC 101

Unit I: Analog Circuits and Systems (Theory) FM: 25, Credit: 02

1. Review of Diode: Applications of diode: rectifier, clipper, clamper, voltage doubler.

2. BJT: BJT biasing, stabilization, methods of stabilization, transfer characteristics of BJT, BJT acts as a switch and a amplifier, small signal analysis of BJT, CB,CE and CC amplifiers, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, high frequency model of BJT.

3. MOSFET: MOSFET operation, small signal and large signal model of a MOSFET. CMOS inverter, MOSFET as a switch and an amplifier, MOS biasing, CS, CD, and CG amplifier using MOSFET.

4. Feedback Amplifiers: Feedback topologies, feedback amplifiers, determination of loop gain, stability of amplifier, Frequency compensation. Hartley, Colpitt's and Phase Shift oscillators.

5. OPAMP: Application of OPAMP, differentiators, integrators, active filters, Comparator, Schmitt triggers, Instrumentation Amplifiers, Logarithmic Amplifiers, Anti-log amplifiers, wave generator.

6. Regulated power supply, voltage regulator using discrete component, series regulation using OP-AMP, details of standard power supply unit, switch mode power supply (SMPS)

Course Outcome (CO)

After completing this course students will acquire knowledge on the following subjects

- Acquire basis concept of different electronic devices.
- Able to design amplifier circuits using Diode, BJT, MOSFET and OP- AMP and learn their different important characteristics.
- Learn about power supply

Unit II: Analog Circuits and Systems (Practical) FM: 25, Credit: 02

1. To study fixed bias circuit of a BJT amplifier: To design a fixed bias transistorized amplifier and measure VBE, VCE, VCB, IC, IB, IE at Q point. Repeat the same with different BJT.

2. To study of self-biased transistorized amplifier: To design a self bias transistorized amplifier and measure VBE, VCE, VCB, IC, IB, IE at Q point. Repeat the same with different BJT.

3. To study the Frequency response of voltage divider bias circuit of BJT on emitter load RE. Study frequency response of voltage divider bias circuit of BJT. To measure midband gain, input impedance and output impedance.

4. To study frequency response of voltage divider bias circuit of BJT using shunted emitter load. Study frequency response of voltage divider bias circuit of BJT. Measure midband gain, input impedance and output impedance. Perform linearity test for given configuration.

5. To study frequency response of emitter follower of BJT: Study frequency response of emitter follower of BJT. Measure of mid band gain, input impedance and output impedance.

6. To design a R-C coupled amplifier of given gain using transistors in CE mode. i) Study the frequency response and calculate its bandwidth. ii) Connect a buffer (C-C amplifier) at the final stage and find its effect.

    a) To construct a regulated power supply using a power transistor as a pass element and an OPAMP as a comparator.

    b) b) Design of variable power supply using LM 317.

7. To design an active first and second order Butterworth filter and study its frequency response characteristics and find the cut-off frequencies.

8. To design of RC phase shift oscillator.

9. To design and Integrator and Differentiator using OP-AMP and draw the transfer characteristics.

Course Outcome (CO)

This is a practical paper on the design of analog circuits in advance level. At the end of course the students are able to:

- Design filters, amplifiers using transistors, regulated power supply, and uses OPAMP to design circuits for integration and differentiation etc. The design process is carried out by using breadboard and discrete electronic components.
- To correlate the theoretical concept of electronic circuit with practical feasibility.
- To acquire experience on electronic circuits for real life applications.

ELC 102

Unit I: Digital System Design (Theory) FM: 25, Credit: 02

1. Logic gates- NOT, AND, OR, NAND, NOR, Ex-OR, Boolean algebra and Karnaugh map simplification SOP and POS form.

2. Combinational Circuit: Analysis and synthesis of combinational circuits, multiplexer, de-multiplexer, encoder, decoder, code-converter, adder, subtractor, comparator, parity generator/checker.

3. Sequential Circuit : Analysis and synthesis of sequential circuits, S-R, D, T, J-K flip-flop, Master –Slave flip-flop, Flip-Flop Conversion, Synchronous & asynchronous counter, register, shift register, Ring and Johnson Counter.

4. Converters: Specification of converter, R-2R ladder type D/A converter, Successive approximation converter.

5. Finite state machine: Analysis and design of fundamental mode state machines: State variables, State table and

Course Outcome (CO)

- Acquire fundamental idea of logic gates and Boolean algebra.
- Obtain knowledge about different combinational logic circuits and sequential logic circuits.
- Acquire knowledge to understand ADC/DAC.
- Acquire knowledge about finite state machine and State diagram.

Unit II: Digital System Design (Practical) FM: 25, Credit: 02

1. Design and Implementation of half adder and full adder circuit.
2. Design and Implementation of multiplexer and demultiplexer circuit.
3. Design and Implementation of magnitude comparator circuit.
4. Design and Implementation of code converter.
5. Design and Implementation of flip flops.
6. Design and Implementation of counter.
7. Design and Implementation of register.
8. Design and implementation of D/A using R-2R ladder.

Course Outcome (CO):

At the end of this course students will.

- Design different combinational and sequential circuits like adder, multiplexer, flip-flops, registers, counters using bread board and ICs
- Learn to correlate the theoretical concept of digital circuits with practical feasibility.
- Gather on hand experience on digital circuits for solving real life problems.

ELC 103

Unit-I: Research Methodology (Theory) FM: 25, Credit: 02

1. Research: Meaning, Types sand Characteristics, Positivism and Post-positivism approach in research,
2. Methods of research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods.
3. Steps of research.
4. Thesis and article writing: Format and styles of referencing. Paper, Article, Workshop, Seminars, Conference, Symposium.
5. Applications of ICT in research.
6. Research ethics.

Course Outcome (CO)

After completing this course the students will acquire knowledge on the following subject

- To develop primary knowledge on how to do research.
- Application of ICT in research
- Develop presentation skill in research.

Unit II: Research Methodology (Practical) FM: 25, Credit: 02

Apart from executing the programs prescribed in the syllabus, students should be encouraged to execute other problems associated with C Programming Language with similar complexity. Write programs using C Programming Language to perform the following tasks: List of Assignments: Find factorial of an integer N, Prime or non-prime, Fibonacci Series, Armstrong

Number, decimal to binary conversion, Sum of AP Series or GP series, Calculation of the functions sin(x), cos(x) and exp(x) by representing each of them as an infinite series, Sort an array of numbers in (a) ascending and (b) descending order using the Bubble sort algorithm. Solve a given polynomial equation numerically using (a) Newtow-Raphson method (b) Bisection meth

Course Outcome (CO)

After completing this course the students will acquire knowledge on the following subject

- To acquire programming skills in C on various mathematical functions required for research.
- To acquire programming skill on numerical analysis.
- To develop the ability to write database applications using C.

ELC 104: Modern Communication & Network Theory, FM 50, Credit 04

Unit I: Modern Communication

1. Fundamentals of Analog Communication: Elements of a communication system, Need for modulation, Principles of Amplitude Modulation (AM),Generation and detection of AM: DSB, SSB, VSB, Principles of Frequency Modulation (FM), FM generation and detection, comparison of AM and FM.

2. Noise in Communication Systems: Introduction to noise, Internal and external noise sources. Noise temperature, Noise figure, Equivalent noise bandwidth. Effect of noise in AM systems, SNR in envelope and coherent detection. Effect of noise in FM receivers, pre-emphasis and de-emphasis.

3. Digital and Mobile Communication: Need for digital communication, overview of sampling and PCM, Digital modulation techniques: ASK and FSK, Digital modulation techniques: PSK and QAM, Applications and bandwidth considerations of digital modulation, Introduction to Mobile Communication: cellular concept, frequency reuse, Overview of generations (2G to 5G), features & applications.

4. Optical & Modern Communication Technologies: Introduction to optical communication, optical fibers, structure, Attenuation and dispersion in fibers, bandwidth advantage. Optical transmitter and receiver basics, Applications of optical communication in telecommunication, Overview of IoT, WiFi, GPS as modern communication applications.

Course Outcome (CO):
After completion of this course the students will be able to:

- Acquire fundamental knowledge on analog communication system like AM, FM and PM. The various techniques of modulation and demodulation.
- Understand the digital modulation system, information theory and data communication.
- Develop problem solving skills on analog and digital communication systems.

Unit II: Network Theory

1. Introduction to network analysis: T - π Transformation, Network theorems: Superposition, Thevenin, Norton and Maximum Power Transfer Theorems, Network elements, Network graphs, Nodal and Mesh analysis.

2. Two-port Network Parameters: Z, Y, ABCD and h parameters.

3. State variable method of circuit analysis, AC circuit analysis, Transient analysis,

4. Network functions, Driving point impedance and Transfer functions, Zero and Poles, Conditions for practical realization of network functions.

5. Filters: Passive filters, Constant K and m-derived filters: low pass, high pass, band pass and band reject filters.

6. Introduction to network simulation software LT-SPICE, Basic ideas to design and simulate the network circuit, Simple problems using SPICE.

Course Outcome (CO)

After completion of this course students will be able to:

- Acquire fundamental knowledge on network theorems, Network topology, Two-port network, Filters,
- Knowledge on Time and frequency response, Network functions.
- Develop problem solving skills on network analysis.

ELC 105

Microprocessor (Theory) FM: 25, Credit: 02

1. Introduction to microprocessor 8085: Architecture of 8085, Address/data bus de-multiplexing, Register organization, Addressing modes, Instruction set, Assembly language program development using instructions. Interrupts, Memory interfacing, Concept of memory mapping.

2. The processor 8086:8086 architecture, Functional block diagram, Register organization, Memory segmentation, Programming modes, Memory access, Physical memory

organization, Signal description of different pins, Timing diagram, Interrupts. Instruction set, Instruction addressing modes, Simple program development using instructions.

3. Interfacing: Memory and I/O interfacing, Memory mapped I/O and peripheral I/O, Basic concepts on the devices 8255A, 8259, 8251 and their interfacing with microprocessor.

4. Serial I/O and data communication: Serial communication protocols, Synchronous and asynchronous communication, RS 232 serial interface standard, IEEE 488 standard, Current loop interface, Error detection and correction.

5. Microcontroller 8051:Architecture of 8051 microcontroller, Memory organization, Addressing modes and instruction set, Useful assembly language programs using instructions of 8051.

Course Outcome (CO):

On the successful completion of this course, students will acquire knowledge on:

- Basic principles of microprocessor and microcontroller.
- Writing programs for microprocessor and microcontroller.
- Interfacing techniques for microprocessor and microcontroller.

ELC 106: Computational Skill with Python (Practical) FM: 25, Credit: 02

1. Introduction to Python : Python Interpreter, syntax, keywords, variables, data types. Operators (arithmetic, relational, logical, assignment). Simple I/O (keyboard input, formatted output). Practical: programs for arithmetic operations, type conversion, and simple expressions.

2. Control Structures & Functions Lectures: Conditional statements (if, if-else, nested), Loops (for, while), break, continue, pass, Functions: definition, arguments, return values, default arguments, Practical: factorial, prime check, Fibonacci sequence, Armstrong number.

3. Strings and Lists in Python Strings: slicing, comparison, string operations, traversal.
Lists: creation, indexing, operations, membership, nested lists, Practical: string palindrome, word count, list sorting/searching, matrix addition.

4. Applications & Problem Solving: Use of Python libraries (math, random).File handling basics (read/write text files).Practical Applications: Numerical integration using

trapezoidal rule, Solve quadratic equation, Simple data analysis with lists (mean, max, min). Plot simple functions using.

Course Outcome (CO)

After completing this course the students will acquire knowledge on the following subject

- To acquire programming skills in core Python.
- To acquire object oriented skills in Python.
- To develop the skill of designing graphical user interfaces in Python.
- To develop the ability to write database applications in Python.

ELC 107: Indian Knowledge System (To be conducted by the University centrally) FM: 25, Credit: 02

Vidyasagar: Life and Philosophy (Compulsory Non-Credit Course)