Terna Engineering College, Nerul, Navi Mumbai
ELECTRONICS Department
COURSE OUTCOME - PROGRAM OUTCOME MAPPING

SEMESTER	SUBJECT CODE	SUBJECT	CO/LO	CO / LO STATEMENT
SEM -III	ELX303	Digital Circuit Design	CO1	Students will be able to implement various logical and arithmetic operations on various number systems as well as conversion of one representation to another.
			CO2	Students will be able to demonstrate Boolean algebra for the implementation and minimization of logic functions.
			CO3	Students will be analyze, design and implement combinational logic circuits.
			CO4	Students will be able to differentiate between logic families TTL and CMOS.
			CO5	Students will be able to analyze, design and implement sequential logic circuits.
			CO6	Students will be able to establish current applications and trends in logic design
	ELX302	Electronic Devices and Circuits I	CO1	1. Students will be able to explain working of semiconductor devices.
			CO2	2. Students will be able to analyze characteristics of semiconductor devices.
			CO3	3. Students will be able to perform DC and AC analysis of Electronics circuits.
			CO4	4. Students will be able to compare various biasing circuits as well as various configurations of BJT,JFET and MOSFETs.
			CO5	5. Students will be able to select best circuit for the given specifications/application.
			CO6	6. Students will be able to design electronics circuits for given specifications.
	ELXL301	Electronic Devices and Circuits I Laboratory	LO1	1. Students will be able to explain working of semiconductor devices.
			LO2	2. Students will be able to analyze characteristics of semiconductor devices.
			LO3	3. Students will be able to perform DC and AC analysis of Electronics circuits.
			LO4	4. Students will be able to compare various biasing circuits as well as various configurations of BJT,JFET and MOSFETs.
			LO5	5. Students will be able to select best circuit for the given specifications/application.
			LO6	6. Students will be able to design electronics circuits for given specifications.
	ELXL302	Digital Circuit Design Lab	LO1	Students will be able to implement various logical and arithmetic operations on various number systems as well as conversion of one representation to another.
			LO2	Students will be able to demonstrate Boolean algebra for the implementation and minimization of logic functions.

		LO3	Students will be analyze, design and implement combinational logic circuits.
		LO4	Students will be able to differentiate between logic families TTL and CMOS.
		LO5	Students will be able to analyze, design and implement sequential logic circuits.
		LO6	Students will be able to establish current applications and trends in logic design
ELXL303	Electrical Network Analysis and Synthesis Lab	LO1	1. Students will be able to apply their understanding of network theorems in analyzing complex circuits.
		LO2	2. Students will be able to evaluate the time and frequency response of electrical circuits and thereby understand the behaviour of electrical networks.
		LO3	3. Students will be able to evaluate the inter-relationship among various circuit parameters and solve complex networks using these parameters.
		LO4	4. Students will be able to synthesize electrical networks for a given network function and design simple filters
		LO5	To understand synthesis of electrical networks
		LO6	To understand various types of filters
ELXL304	Object Oriented Programming Methodology Lab.	LO1	1.To apply fundamental programming constructs.
		LO2	2.To illustrate the concept of packages, classes and objects.
		LO3	3.To elaborate the concept of strings, arrays and vectors.
		LO4	4.To implement the concept of inheritance and interfaces.
		LO5	5.To implement the notion of exception handling and multithreading.
		LO6	6.To develop GUI based application.
ELX304	Electrical Network Analysis and Synthesis	CO1	1. Students will be able to apply their understanding of network theorems in analyzing complex circuits.
		CO2	2. Students will be able to evaluate the time and frequency response of electrical circuits and thereby understand the behaviour of electrical networks.
		CO3	3. Students will be able to evaluate the inter-relationship among various circuit parameters and solve complex networks using these parameters.
		CO4	4. Students will be able to synthesize electrical networks for a given network function and design simple filters
		CO5	To understand synthesis of electrical networks
		CO6	To understand various types of filters
ELX305	**Electronics Instruments and Measurement(Mech**	CO1	Students will be able to describe the static & dynamic characteristics of an instrument, components of general instrumentation system & different types of errors in the measurement process

		atronics)	CO2	Students will be analyze various test & measuring instruments including AC and DC bridges to determine the unknown quantity under measurement
			CO3	Students will be able to use cathode ray oscilloscope (CRO) to perform wide range of simple to complex measurement functions for voltage, current, frequency, phase & component testing
			CO4	Students will be able to select choice of transducer for practical & real-life applications based on their principle of operation, working, construction & characteristics
	ELX301	**Applied Mathematics III**	CO1	Understand the concept of Laplace transform and its application to solve the real integrals
			CO2	Understand the concept of inverse Laplace transform of various functions and its applications in
			CO3	Understand the concept ofthe concept of Fourier Series, its complex form and enhance the problem
			CO4	Expand the periodic function by using Fourier series for real life problems and complex engineering
			CO5	Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories andanalytic function.
			CO6	To understand the basics of Linear Algebra.
SEM -IV	**ELX401**	**Applied Mathematics IV**	CO1	Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate
			CO2	Apply the concept of Correlation and Regression to the engineering problems
			CO3	Apply the concepts of probability and expectation for getting the spread of the data anddistribution of probabilities.
			CO4	Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
			CO5	Use the concept of Quadratic forms and Singular value decomposition which are very
			CO6	Find the extremals of the functional using the concept of Calculus of variation.
	ELX402	**Electronic Devices**	CO1	1. Students will be able to Ability to understand amplifiers through frequency response.

	and Circuits II	CO2	2. Students will be able to perform DC and Ac analysis of single stage and multistage amplifiers, oscillators, differential amplifiers and power amplifiers.
		CO3	3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters.
		CO4	4. Student will be able to select appropriate circuit for given specifications/applications.
		CO5	5. Students will be able to explain working and construction details of special, semiconductor devices.
ELX403	**Microprocessors and Applications**	CO1	1.Students will be able to understand and explain 16-bit microprocessor architecture.
		CO2	2.Students will be able to understand and write programmes for 8086 microprocessor.
		CO3	3.Students will be able to use various peripheral devices to design Single Board
		CO4	4.Students will be able to understand and explain 32-bit microprocessor architecture.
ELX404	Digital System Design	CO1	Students will be able to design and implement synchronous sequential logic circuits.
		CO2	Students will be able to analyze various types of digital logic circuits.
		CO3	Students will be able to understand engineering concepts in the design of digital circuits.
		CO4	Students will be able to understand the role of hardware description languages in digital
		CO5	Students will be able to describe simple hardware functions using a hardware description language
		CO6	Students will be able to understand the purpose of and steps involved in digital circuit implementation using Field-Programmable Gate Array
ELX405	Principles of Communication Engineering	CO1	1. Students will be able to comprehend the need for various components in analog communication systems
		CO2	2. Students will be able to analyse various analog modulation methods
		CO3	3. Students will be able to design modulators, demodulators for amplitude and frequency modulated systems.
		CO4	4. Students will be able to assess the characteristics of pulse modulation techniques.
		CO5	5. Recognize the need for multiplexing techniques.
ELX406	Linear Control Systems	CO1	1. Students will be able to understand the basic concepts of control system and identify control systems in real life applications.
		CO2	2. Students will be able to derive the mathematical model of different types of control systems and represent them in various forms
		CO3	3. Students will be able to analyze systems using time domain analysis techniques

		CO4	4. Students will be able to apply concepts of frequency domain techniques in stability analysis of control systems
		CO5	5. Students will be able to create state variable models of systems andanalyze their controllability, observability and time response
		CO6	6. Students will be able to identify controllers and compensators in different controllers
ELXL 401	Electronic Devices and Circuits II Lab	LO1	1. Students will be able to Ability to understand amplifiers through frequency response.
		LO2	2. Students will be able to perform DC and Ac analysis of single stage and multistage amplifiers, oscillators, differential amplifiers and power amplifiers.
		LO3	3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters.
		LO4	4. Student will be able to select appropriate circuit for given specifications/applications.
		LO5	5. Students will be able to explain working and construction details of special, semiconductor devices.
ELXL 402	Microprocessors and Applications Lab	LO1	1.Students will be able to understand and explain 16-bit microprocessor architecture.
		LO2	2.Students will be able to understand and write programmes for 8086 microprocessor.
		LO3	3.Students will be able to use various peripheral devices to design Single Board Computer(SBC).
		LO4	4.Students will be able to understand and explain 32-bit microprocessor architecture.
ELXL 403	Digital System Design Lab	LO1	Students will be able to design and implement synchronous sequential logic circuits.
		LO2	Students will be able to analyze various types of digital logic circuits.
		LO3	Students will be able to understand engineering concepts in the design of digital circuits.
		LO4	Students will be able to understand the role of hardware description languages in digital circuit implementation.
		LO5	Students will be able to describe simple hardware functions using a hardware description language
		LO6	Students will be able to understand the purpose of and steps involved in digital circuit implementation using Field-Programmable Gate Array
ELXL 404	Principles of Communication Engineering Lab	LO1	1. Students will be able to comprehend the need for various components in analog communication systems
		LO2	2. Students will be able to analyse various analog modulation methods
		LO3	3. Students will be able to design modulators, demodulators for amplitude and frequency modulated systems.

			LO4	4. Students will be able to assess the characteristics of pulse modulation techniques.
			LO5	5. Recognize the need for multiplexing techniques.
			LO6	
SEM V	ELX504	Design with Linear Integrated Circuits	CO1	Demonstrate an understanding of fundamentals of integrated circuits.
			CO2	Analyze the various applications and circuits based on particular linear integrated circuit.
			CO3	Design linear and non linear op amp circuits.
			CO4	Select and use an appropriate integrated circuit to build a given application.
			CO5	Analyze and design various regulator circuits
			CO6	Design an application with the use of integrated circuit
	ELX502	Digital Communication	CO1	Comprehend the advantages of digital communication over analog communication and explain need for various subsystems in digital communication systems
			CO2	Realize the implication of Shannon –Hartley Capacity theorem while designing the efficient sourse encoding technique
			CO3	Understand the impact of Intersymbol Interference in Baseband transmission and methods to mitigate it effect
			CO4	Analze various digital modulation methods and assess them based on parameters such as spectral efficiency , power efficiency , probability of error in detection
			CO5	Explain the concept and need for designing efficient Forward error correcting codes
			CO6	Realize the area of application of Digital communication.
	ELX505	Business Communication & Ethics	CO1	Design a technical document using precise language, suitable vocabulary and apt style
			CO2	Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
			CO3	Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities
			CO4	Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
			CO5	Deliver formal presentations effectively implementing the verbal and non-verbal skill
	ELXL501	Microcontrollers and Applications lab	LO1	1. Explain 8051 microcontroller architecture.
			LO2	2. Develop assembly language programmes for 8051 microcontroller.
			LO3	3. Design and implement 8051 based systems.
			LO4	4. Explain advanced features of Cortex-M3 architecture.

ELXL502	Digital Communication lab	LO1	Comprehend the advantages of digital communication over analog communication and explain need for various subsystems in digital communication systems
		LO2	Realize the implication of Shannon –Hartley Capacity theorem while designing the efficient sourse encoding technique
		LO3	Understand the impact of Intersymbol Interference in Baseband transmission and methods to mitigate it effect
		LO4	Analze various digital modulation methods and assess them based on parameters such as spectral efficiency , power efficiency , probability of error in detection
		LO5	Explain the concept and need for designing efficient Forward error correcting codes
		LO6	Realize the area of application of Digital communication.
ELXL503	Design with Linear Integrated Circuits lab	LO1	Demonstrate an understanding of fundamentals of integrated circuits.
		LO2	Analyze the various applications and circuits based on particular linear integrated circuit.
		LO3	Design linear and non linear op amp circuits.
		LO4	Select and use an appropriate integrated circuit to build a given application.
		LO5	Analyze and design various regulator circuits
		LO6	Design an application with the use of integrated circuit
ELX503	Engineering Electromagnetics	CO1	Analyze the behaviour of electromagnetic waves in different media.
		CO2	Evaluate various parameters of transmission lines and radiating systems.
		CO3	Apply computational techniques to analyze electromagnetic field distribution.
		CO4	Understand different mechanisms of radio wave propagation.
ELX501	Microcontrollers and Applications	CO1	1. Explain 8051 microcontroller architecture.
		CO2	2. Develop assembly language programmes for 8051 microcontroller.
		CO3	3. Design and implement 8051 based systems.
		CO4	4. Explain advanced features of Cortex-M3 architecture.
ELXDLO5011	Database and Management System	CO1	Understand the fundamentals of a database systems
		CO2	Design and draw ER and EER diagram for the real life problem
		CO3	Convert conceptual model to relational model and formulate relational algebra queries
		CO4	Design and querying database using SQL.
		CO5	Analyze and apply concepts of normalization to relational database design.
		CO6	Understand the concept of transaction, concurrency and recovery.

	ELXDLO50 11	Database and Management System lab	CO1	Explain the fundamentals of a database system
			CO2	Design and query a database using Basic SQL statements
			CO3	Create and update database using different DDL and DML statements.
			CO4	Create and execute Complex queries
			CO5	Apply triggers, cursor and procedures for a specific task
			CO6	Construct a relational database schema from an ER/EER conceptual model, experiment with concurrent transactions and access data through front end (using JDBC ODBC connectivity.)
SEM -VI	ELX 601	Embedded System and RTOS	CO1	Identify and describe various characteristic features and applications of embedded systems.
			CO2	Analyse and identify hardware for embedded systems implementation
			CO3	Analyse and identify various software issues involved in Embedded systems for real time requirements.
			CO4	Analyse and explain the design life-cycle for embedded system implementation.
	ELX604	Signals and systems	CO1	Differentiate between continuous time and discrete time signals and systems.
			CO2	Understand various transforms for time domain to frequency domain conversion.
			CO3	Apply frequency domain techniques for analysis of LTI systems.
			CO4	Apply frequency domain techniques for analysis of continuous time and discrete time
	ELXDLO60 24	Electronics Product Design	CO1	To understand the stages of product (hardware / software) design & development
			CO2	To learn different considerations of analog, digital & mixed circuit design
			CO3	To be acquainted with methods of PCB design & different tools used for the same
			CO4	To be aware of the importance of testing in product design cycle
			CO5	To gain knowledge about various processes & importance of documentation
			CO6	To become familiar with product life cycle of electronic product
	ELXL602	Computer Communication Network Lab	LO1	.Demonstrate understanding of networking concepts and required protocols
			LO2	. Analyze the various layers and protocols of the layered architecture
			LO3	Evaluate different addressing schemes, connecting devices and routing protocols
			LO4	Appreciate the application layer protocols
	ELX603	VLSI Design	CO1	Demonstrate a clear understanding of choice of technology, scaling, MOS models and system level design issues
			CO2	Design and analyze MOS based inverters.

			CO3	Design MOS based circuits with different design styles.
			CO4	Design semiconductor memories, adders and multipliers.
			CO5	Design semiconductor memories.
			CO6	Design adders and multipliers.
	ELXL603	VLSI Design Lab	LO1	Demonstrate a clear understanding of choice of technology, scaling, MOS models and system level design issues
			LO2	Design and analyze MOS based inverters.
			LO3	Design MOS based circuits with different design styles.
			LO4	Design semiconductor memories, adders and multipliers.
			LO5	Design semiconductor memories.
			LO6	Design adders and multipliers.
	ELX602	Computer Communication Network	CO1	.Demonstrate understanding of networking concepts and required protocols
			CO2	. Analyze the various layers and protocols of the layered architecture
			CO3	Evaluate different addressing schemes, connecting devices and routing protocols
			CO4	Appreciate the application layer protocols
			CO5	familiar with the network topology and basic protocols of computer networks and how they can be used to assist in network design and implementation
			CO6	Build the skills of subnetting and routing mechanisms
	ELXL601	Embedded System and RTOS Lab	LO1	Identify and describe various characteristic features and applications of embedded systems.
			LO2	Analyse and identify hardware for embedded systems implementation
			LO3	Analyse and identify various software issues involved in Embedded systems for real time requirements.
			LO4	Analyse and explain the design life-cycle for embedded system implementation.
	ELXLDLO6024	Electronics Product Design Lab	LO1	To understand the stages of product (hardware / software) design & development
			LO2	To learn different considerations of analog, digital & mixed circuit design
			LO3	To be acquainted with methods of PCB design & different tools used for the same
			LO4	To be aware of the importance of testing in product design cycle
			LO5	To gain knowledge about various processes & importance of documentation
			LO6	To become familiar with product life cycle of electronic product
SEM-VII	ELXDLO70	IC Technology	CO1	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling

34		CO2	Demonstrate a clear understanding of various MOS fabrication processes.
		CO3	Demonstrate a clear understanding of Semiconductor measurements, packaging and testing
		CO4	Demonstrate a clear understanding of advanced semiconductor technologies.
		CO5	Discuss physical mechanism in novel devices
		CO6	Verify processes and device characteristics via simulations
ELX701	Instrumentation System Design	CO1	Demonstrate the needs of advancement in instrumentation systems
		CO2	Select the proper components for pneumatic & hydraulic systems
		CO3	Choose the transmitter / controller for given process application
		CO4	Analyze the controller parameters for discrete or continuous type
		CO5	Design the controller (electronic) for a given process or application
ELX702	Power Electronics	CO1	Discuss trade-offs involved in power semiconductor devices.
		CO2	Design of triggering, commutation and protection circuits for SCRs.
		CO3	Analyse different types of single-phase rectifiers and DC-DC converters
		CO4	Analyse different types of DC-AC converters (inverters).
		CO5	Analyse different types of AC Voltage Controllers and Cycloconvertor
		CO6	Analyse different types of DC-DC converters.
ELX703	Digital signal processing	CO1	To explore the properties of DFT and use FFT Algorithms.
		CO2	To learn the design IIR digital filters using Impulse invariance and Bilinear Transformation.
		CO3	To Design FIR digital filters using Windowing and Frequency sampling method.
		CO4	To calculate errors due to finite word length effects in filter design.
		CO5	Apply Decimation and Interpolation technique in signal processing.
		CO6	To learn need and applications of Digital Signal Processors.
ELXL702	Power Electronics Lab	LO1	Discuss trade-offs involved in power semiconductor devices.
		LO2	Design of triggering, commutation and protection circuits for SCRs.
		LO3	Analyse different types of single-phase rectifiers and DC-DC converters
		LO4	Analyse different types of DC-AC converters (inverters).
		LO5	Analyse different types of AC Voltage Controllers and Cycloconvertor
		LO6	Analyse different types of DC-DC converters.
ELXLDLO7 034	Integrated Circuit Technology Lab	LO1	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling
		LO2	Demonstrate a clear understanding of various MOS fabrication processes.

			LO3	Demonstrate a clear understanding of Semiconductor measurements, packaging and testing
			LO4	Demonstrate a clear understanding of advanced semiconductor technologies.
			LO5	Discuss physical mechanism in novel devices
			LO6	Verify processes and device characteristics via simulations
	ELXL703	Digital signal processing Lab	CO1	To explore the properties of DFT and use FFT Algorithms.
			CO2	To learn the design IIR digital filters using Impulse invariance and Bilinear Transformation.
			CO3	To Design FIR digital filters using Windowing and Frequency sampling method.
			CO4	To calculate errors due to finite word length effects in filter design.
			CO5	Apply Decimation and Interpolation technique in signal processing.
			CO6	To learn need and applications of Digital Signal Processors.
	ELXL701	Instrumentation System Design Lab	LO1	Demonstrate the needs of advancement in instrumentation systems
			LO2	Select the proper components for pneumatic & hydraulic systems
			LO3	Choose the transmitter / controller for given process application
			LO4	Analyze the controller parameters for discrete or continuous type
			LO5	Design the controller (electronic) for a given process or application
SEM VIII	ELXDLO8042	MEMS Technology Mrs. V. A. Pande	CO1	Explain the applications of MEMS to disciplines beyond electrical & mechanical Engg.
			CO2	Distinguish the different materials used for MEMS and selection of materials based on
			CO3	Select MEMS Fab processes based on Applications
			CO4	Identify the optimal micro fabrication and packaging techniques applicable to micro
			CO5	Explain the underlying fundamental principles of MEMS devices including physical
			CO6	Develop different concepts of micro system sensors and actuators for real-world
	ELX802	**Analog & Mixed VLSI Design**	CO1	Discuss tradeoffs and design building blocks of CMOS analog circuits.
			CO2	Evaluate MOSFET based single stage and differential amplifiers.
			CO3	Analyze and design basic MOSFET based operational amplifiers.
			CO4	Evaluate Mixed Signal circuits
			CO5	Discuss DAC/ADC converters specifications and architectures.
			CO6	Carry out verifications of issues involved in analog circuits via simulations.
	ELXL802	**Analog & Mixed VLSI Design Lab**	LO1	Discuss tradeoffs and design building blocks of CMOS analog circuits.
			LO2	Evaluate MOSFET based single stage and differential amplifiers.
			LO3	Analyze and design basic MOSFET based operational amplifiers.
			LO4	Evaluate Mixed Signal circuits

		LO5	Discuss DAC/ADC converters specifications and architectures.
		LO6	Carry out verifications of issues involved in analog circuits via simulations.
ELX801	Internet of Things	CO1	Understand the concepts of Internet of Things
		CO2	Analyze basic web connectivity in IoT
		CO3	Understand Data handling in IoT
		CO4	Design basic applications based on IoT using specific components
ELXDLO8044	Digital Image Processing	CO1	Understand the fundamentals of Digital Image representation and simple pixel relations.
		CO2	Explain spatial domain and frequency domain techniques for digital image enhancement.
		CO3	Perform segmentation and morphological operations.
		CO4	Apply compression and decompression techniques to different digital images.
ILO8029	Environmental Management	CO1	To understand about environment, significance of Environment Management, career opportunities, sustainable development, energy scenario and environmental issues relevant to India
		CO2	To understand issues relevant to Global Environmental concerns.
		CO3	To understand concepts of ecology, ecosystems, their interdependence between living organisms, habitats, limiting factors, carrying capacity and food chain.
		CO4	To understand scope of Environment Management, Role & functions of Government as a planning and regulating agency, total quality environmental management, ISO-14000 and EMS certification.
		CO5	To understand major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act.
ELXLDLO8044	Digital Image Processing Lab	LO1	Understand the fundamentals of Digital Image representation and simple pixel relations.
		LO2	Explain spatial domain and frequency domain techniques for digital image enhancement.
		LO3	Perform segmentation and morphological operations.
		LO4	Apply compression and decompression techniques to different digital images.
ELXL801	Internet of Things Lab	LO1	Understand the concepts of Internet of Things
		LO2	Analyze basic web connectivity in IoT
		LO3	Understand Data handling in IoT
		LO4	Design basic applications based on IoT using specific components
ELXLDLO8	MEMS Technology	LO1	Explain the applications of MEMS to disciplines beyond electrical & mechanical Engg.

042	Lab	LO2	Distinguish the different materials used for MEMS and selection of materials based on application
		LO3	Select MEMS Fab processes based on Applications
		LO4	Identify the optimal micro fabrication and packaging techniques applicable to micro systems
		LO5	Explain the underlying fundamental principles of MEMS devices including physical operation, mathematical modeling and fabrication
		LO6	Develop different concepts of micro system sensors and actuators for real-world applications and Design and simulate these devices and system using standard simulation tools