Terna Engineering College, Nerul, Navi Mumbai
ELECTRONICS Department
COURSE OUTCOMES

SEM	SUBJECT CODE	SUBJECT	CO/LO	CO / LO STATEMENT
SEM III	ELC305	EIM	CO1	students will be able to Recall and define instrument characteristics as well as interpret errors in measurements.
			CO2	students will be able toUnderstand and Measure various variables or value of unknown element.
			CO3	students will be able to Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
			CO4	students will be able to Explain various components of oscilloscopes.
			CO5	students will be able toChoose appropriate transducer for measurement of distance, temperature and pressure.
			CO6	students will be able to Develop a calibration scheme for given instrument.
	ELC302	EDC-I	CO1	Students will be able to explain working of semiconductor devices.
			CO2	. Students will be able to analyze characteristics of semiconductor devices.
			CO3	Students will be able to perform DC and AC analysis of Electronics circuits.
			CO4	Students will be able to compare various biasing circuits as well as various configurations of BJT and MOSFETs
			CO5	Students will be able to select best circuit for the given specifications/application
	ELC303	Digital Logic Circuits	CO1	1. Students will be able to perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
			CO2	2. Students will be able to analyse, design and implement Combinational logic circuits.
			CO3	3. Students will be to analyze, design and implement Sequential logic circuits.
			CO4	4. Students will be able to design and implement various counter using flip flops, FSMs and MSI chips.
			CO5	5. Students will be able to understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
			CO6	6. Students will be able to understand basics of Verilog Hardware Description Language and its programming with combinational and sequential logic circuits.
	ELC304	ENAS (RRT)	CO1	CO1- Explain basic electrical circuits with nodal and mesh analysis
			CO2	CO2- apply network theorems.
			CO3	CO3- Laplace Transform for steady state and transient analysis.
			CO4	CO4- Determine different network functions and solve complex circuits using network parameters.

		CO5	CO5- Realize electrical networks for given network functions using synthesis concepts.
		CO6	CO6- Design various types of filters....
ELC301	**AM-III (KKR)**	CO1	CO1-Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems
		CO2	CO2- Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
		CO3	CO3- Expand the periodic function by using problems. Fourier series for real life problems and complex engineering
		CO4	CO4- Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
		CO5	CO5- Use matrix algebra to solve the engineering problems.
		CO6	CO6- Apply the concepts of vector calculus in real life problems.
ELL301	**EDC-1 LAB**	LO1	Students will be able to explain working of semiconductor devices.
		LO2	. Students will be able to analyze characteristics of semiconductor devices.
		LO3	Students will be able to perform DC and AC analysis of Electronics circuits.
		LO4	Students will be able to compare various biasing circuits as well as various configurations of BJT and MOSFETs
		LO5	Students will be able to select best circuit for the given specifications/application
		LO6	Students will be able to design electronics circuits for given specifications
ELL302	**DLC LAB**	LO1	1. Students will be able to perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
		LO2	2. Students will be able to analyse, design and implement Combinational logic circuits.
		LO3	3. Students will be to analyze, design and implement Sequential logic circuits.
		LO4	4. Students will be able to design and implement various counter using flip flops, FSMs and MSI chips.
		LO5	5. Students will be able to understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
		LO6	6. Students will be able to understand basics of Verilog Hardware Description Language and its programming with combinational and sequential logic circuits.
ELL303	**EIM LAB**	LO1	students will be able to Demonstrate the instrument characteristics as well as interpret errors in measurements
		LO2	students will be able to Measure various variables or value (R, L and C) of unknown element.
		LO3	students will be able to Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer
		LO4	students will be able to Explain various functions of oscilloscopes

			LO5	students will be able to Choose appropriate transducer for measurement of distance, temperature and pressure
			LO6	students will be able to Develop a calibration scheme for given instrument.
	ELL304	**SBL LAB**	LO1	Use C++ in programming
			LO2	. 2. Use different control structures
			LO3	3. Understand fundamental features of an object oriented language: object classes and interfaces, exceptions and libraries of object collections
			LO4	4. Understand Java Programming
			LO5	5. To develop a program that efficiently implements the features and packaging concept of java in laboratory.
			LO6	6. To implement Exception Handling and Applets using Java.
	ELM301	**Mini Project - 1A**	LO1	Identify problems based on societal /research needs
			LO2	Apply Knowledge and skill to solve societal problems in a group
			LO3	Develop interpersonal skills to work as member of a group or leader
			LO4	Draw the proper inferences from available results through theoretical/ experimental/simulations.
			LO5	Analyse the impact of solutions in societal and environmental context for sustainable development.
			LO6	Use standard norms of engineering practices
SEM-IV	**ELC404**	**PCE [SMK]**	CO1	Students will be able to describe the various elements of communication system
			CO2	Students will be able to recognize the need for multiplexing techniques.
			CO3	Students will be able to understand different modulation techniques
			CO4	Illustrate generation and detection of amplitude and frequency modulated systems.
			CO5	Students will be able to characterize pulse modulation techniques.
	ELC401	**AM-IV**	CO1	CO1.Students will be able to Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
			CO2	CO2.Students will be able to Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.
			CO3	CO3.Students will be able to Apply the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
			CO4	CO4. Students will be able to Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
			CO5	CO5.Students will be able to Use the concept of Quadratic forms and Singular value decomposition which are very useful tools in various Engineering applications.

		CO6	CO6. Students will be able to Find the extremals of the functional using the concept of Calculus of variation
ELC403	**MCA**	CO1	CO1. To explain fundamental concepts of microcontrollers.
		CO2	CO2.To understand architecture of 8051 microcontroller
		CO3	CO3: To be familiar with instruction set of 8051
		CO4	CO4: To develop programming skills for microcontrollers using Assembly and C concepts
		CO5	CO5: To interface various devices to the microcontroller
		CO6	CO6: To design and implement microcontroller-based systems.
ELC402	**EDC2**	CO1	CO1. Students will be able to understand performance of amplifiers with the help of frequency response.
		CO2	CO2. Students will be able to perform DC and Ac analysis of single stage and multistage amplifiers, oscillators, differential amplifiers and power amplifiers.
		CO3	CO3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters
		CO4	CO4. Student will be able to select appropriate circuit for given specifications/applications
		CO5	CO5. Students will be able to perform of single stage and multistage amplifiers
		CO6	CO6.. Students will be able to perform power amplifiers
ELC405	**SS**	CO1	CO1. Identify and differentiate between continuous and discrete time signals and systems.
		CO2	CO2. Develop input output relationship for LTI systems.
		CO3	C03. Apply the concept of Laplace transform and understand conversion from time domain to frequency domain for continuous time systems.
		CO4	CO4. Apply the concept of Z transform and comprehend conversion from time domain to frequency domain for discrete time systems.
		CO5	CO5. Analyse continuous time signals using Fourier series.
		CO6	CO6. Analyse discrete time signals using Fourier Transform
ELL404	**Skill based Lab (Python Programming)**	CO1	To apply fundamental programming constructs such as I/O statements, variables, data types and syntax of Python Programming to engineering problems.
		CO2	To make use of data structures, operators and different control structures of Python in solving day to day problems.
		CO3	To Understand and make use of fundamental features of an object oriented programming language Python.
		CO4	To understand user interface and Design GUI for any Applications in Python.
		CO5	To express proficiency in the handling Python libraries related to Image processing, data science, AI etc.

			CO6	To Develop Engineering Domain based Mini project.
	ELL401	**EDC-2 LAB**	CO1	CO1. Students will be able to understand performance of amplifiers with the help of frequency response.
			CO2	CO2. Students will be able to perform DC and Ac analysis of single stage and multistage amplifiers, oscillators, differential amplifiers and power amplifiers.
			CO3	CO3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters
			CO4	CO4. Student will be able to select appropriate circuit for given specifications/applications
			CO5	CO5. Students will be able to perform of single stage and multistage amplifiers
			CO6	CO6.. Students will be able to perform power amplifiers
	ELL402	**MCA LAB**	CO1	To explain fundamental concepts of microcontrollers.
			CO2	To develop programming skills for microcontrollers using Assembly and C concepts.
			CO3	To interface various devices to the microcontroller
			CO4	To design and implement microcontroller-based systems.
			CO5	
			CO6	
	ELL403	**ACLAB**	CO1	Students will be able to describe the various elements of communication system
			CO2	Students will be able to recognize the need for multiplexing techniques.
			CO3	Students will be able to understand different modulation techniques
			CO4	Illustrate generation and detection of amplitude and frequency modulated systems.
			CO5	Students will be able to characterize pulse modulation techniques.
			CO6	Characterize pulse modulation techniques.
	EML401	**Mini project 1B**	CO1	Students will be able to Draw the proper inferences from available results through theoretical/experimental/ simulations.
			CO2	Students will be able to Analyse the impact of solutions in societal and environmental context for sustainable development.
			CO3	Students will be able to Use standard norms of engineering practices
			CO4	Students will be able to Excel in written and oral communication.
			CO5	Students will be able to Demonstrate capabilities of self-learning in a group, which leads to life long learning.
			CO6	Students will be able to Demonstrate project management principles during project work
SEM-V	**ELC503**	**LIC**	CO1	Demonstrate an understanding of fundamentals of integrated circuits.
			CO2	Analyze the various applications and circuits based on particular linear integrated circuit.
			CO3	Select and use an appropriate integrated circuit to build a given application.

		CO4	Design an application with the use of integrated circuit
		CO5	Design a real life application using certain linear Integrated Circuits
		CO6	Design of power supply with proper selection of the regulator IC.
ELDO501	**COA**	CO1	Define the performance metrics of a Computer.
		CO2	Discuss about design aspects of processor, control unit & distinguish between CISC and RISC.
		CO3	Explain the concept of various memories and their design considerations
		CO4	Describe the design consideration of I/O in computer systems.
		CO5	Analyze and apply Parallelism and Pipelining concepts to improve performance.
		CO6	Evaluate the various architectural enhancements in modern processors
ELC502	**DSP**	CO1	Compute DFT using FFT algorithms
		CO2	Distinguish/ Correlate the Digital filter from analog filter and design IIR filters.
		CO3	Select digital filter and design the same using FIR windowing and frequency sampling.
		CO4	Analyze finite word length effects on filter Design.
		CO5	Apply Decimation and Interpolation technique in signal processing.
		CO6	Develop applications of DSP, Identify need and architecture of DSP Processor.
ELC501	**PCS**	CO1	Derive the mathematical models of physical systems.
		CO2	Sketch various plots in time and frequency domain and analyse the system using the plots.
		CO3	Evaluate the stability of control systems in time and frequency domain
		CO4	Design performance specification based controller for a given system.
		CO5	Analyse the control systems using state-space methods and design state feedback controllers.
		CO6	Design performance specification based controller for a given system
ELC504	**DC**	CO1	Comprehend the advantages of digital communication over analog communication and explain need for various
		CO2	Realize the implications of Shannon-Hartley Capacity theorem while designing the efficient Source encoding
		CO3	Understand the impact of Inter Symbol Interference in Baseband transmission and methods to mitigate its
		CO4	Analyze various Digital modulation methods and assess them based on parameters such as spectral efficiency,
		CO5	Explain the concept and need for designing efficient Forward Error Correcting codes.
		CO6	Understand the Optimum reception of Digital signals
ELL501	**PCSL**	LO1	Analyse a control system in time and frequency domain
		LO2	Design a performance specification based controller in time and frequency domain.
		LO3	Develop and tune PID controller for given control system.
		LO4	Evaluate controllability and observability of a control system.
		LO5	Design a state feedback controller according to given specifications.
		LO6	
ELL502	**LICL**	LO1	Demonstrate an understanding of fundamentals of integrated circuits

		LO2	Analyze the various applications and circuits based on particular linear integrated circuit.
		LO3	Select and use an appropriate integrated circuit to build a given application.
		LO4	Design an application with the use of integrated circuit
		LO5	Demonstrate use of ADC and DAC to sense and control physical quantities
		LO6	Design the Power supply for the given specifications.
ELL503	DCL	LO1	Comprehend the advantages of digital communication over analog communication and explain need for various subsystems in Digital communication systems
		LO2	Realize the implications of Shannon-Hartley Capacity theorem while designing the efficient Source encoding technique.
		LO3	Understand the impact of Inter Symbol Interference in Baseband transmission and methods to mitigate its effect.
		LO4	Analyze 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	Understand the Optimum reception of Digital signals
ELL504	Professional Communication and Ethics - II	CO1	Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles
		CO2	Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
		CO3	Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
		CO4	Deliver persuasive and professional presentations
		CO5	Develop creative thinking and interpersonal skills required for effective professional communication
		CO6	Apply codes of ethical conduct, personal integrity and norms of organizational behavior.
ECM501	Mini Project - 2A	CO1	Identify problems based on societal /research needs
		CO2	Apply knowledge and skill to solve societal problems in a group
		CO3	Develop interpersonal skills to work as member of a group or leader.
		CO4	Draw the proper inferences from available results through theoretical/experimental/simulations
		CO5	Analyze the impact of solutions in societal and environmental context for sustainable development
		CO6	Use standard norms of engineering practices.
		CO7	Excel in written and oral communication.
		CO8	Demonstrate capabilities of self-learning in a group, which leads to life-long learning

			CO9	Demonstrate project management principles during project work
SEM-VI	ELC601	Basic VLSI Design	CO1	Demonstrate a clear understanding of choice of technology, scaling, MOS models and
			CO2	Demonstrate a clear understanding of system level design issues.
			CO3	Design and analyze MOS based inverters.
			CO4	Design MOS based circuits with different design styles.
			CO5	Design semiconductor memories.
			CO6	Design adders and multipliers
	ELC 603	CCN	CO1	1. Demonstrate understanding of networking concepts and required protocols.
			CO2	2. Analyze the various layers and protocols of the layered architecture.
			CO3	3. Evaluate different addressing schemes, connecting devices and routing protocols.
			CO4	4. Analyze various routing protocols in Network layer.
			CO5	5. Understand the various protocols in Transport layer
			CO6	6. Comprehend the different protocols in application layer
	ELC604	ESRT	CO1	Identify and describe various characteristic features and applications of embedded systems.
			CO2	Analyze and select hardware for embedded system implementation.
			CO3	3. Evaluate various communication protocols for embedded system implementation.
			CO4	Compare GPOS and RTOS and investigate the concepts of RTOS.
			CO5	Evaluate and use various tools for testing and debugging embedded systems
			CO6	Design a system for different requirements based on life-cycle for the embedded system, keeping oneself aware of ethics and environmental issues.
	ELDO601	ML	CO1	keeping oneself aware of ethics and environmental issues.
			CO2	Students will be able to comprehend regression and classification
			CO3	Students will be able to design apply different dimensionality reduction and comprehend clustering methods.
			CO4	Students can able to analyze learning models.
			CO5	Students will be able to apply and justify various supervised and unsupervised classification and clustering techniques.
			CO6	Student will be able to demonstrate understanding to real life problems.
	ELL602	CCNL	LO1	1. Demonstrate understanding of networking concepts and required protocols.
			LO2	2. Analyze the various layers and protocols of the layered architecture.
			LO3	3. Evaluate different addressing schemes, connecting devices and routing protocols.
			LO4	4. Analyze various routing protocols in Network layer.
			LO5	5. Understand the various protocols in Transport layer

			LO6	6. Comprehend the different protocols in application layer
	ELC602	**EE**	CO1	Apply vector calculus to static electric and magnetic fields in different engineering situations
			CO2	.Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
			CO3	Analyze the phenomena of electromagnetic wave propagation in different media and in applications of microwave engineering.
			CO4	Analyze the nature of electromagnetic wave propagation through transmission lines.
			CO5	Evaluate and analyze different antenna structures and their applications.
			CO6	Examine the sources of EMI and identify methods to ensure compatibility as per existing standards for electrical and electronic systems..
	ELL601	**BVDL**	LO1	Develop circuits using SPICE / circuit simulators.
			LO2	Design and analyze MOS based inverters.
			LO3	Verify different MOS circuit design styles.
			LO4	Validiate functionality of Combinational and Sequential Circuits using different design styles.
			LO5	Examine various semiconductor memories using MOS logic.
			LO6	Enhance skills of building adder, multiplier and shifter circuits using MOS logic.
	ELL603	**ESRTL**	LO1	Interface various sensors and actuators to embedded cores.
			LO2	Write code using RTOS for multi-tasking Embedded systems
			LO3	Design applications using different embedded cores
	EELL604	**DMSL**	LO1	Identify the need of database, and define the problem statement for real life applications.
			LO2	Create relational model for real life applications
			LO3	Formulate query using SQL for efficient retrieval of data
	ELM601	**Mini Project-2B**	LO1	Draw the proper inferences from available results through theoretical/ experimental/simulations
			LO2	Analyze the impact of solutions in societal and environmental context for sustainable development.
			LO3	Use standard norms of engineering practices
			LO4	Excel in written and oral communication.
			LO5	Demonstrate capabilities of self-learning in a group, which leads to life-long learning.
			LO6	Demonstrate project management principles during project work.
SEM-VII	**ELC701**	**PE -BGH**	**CO1**	Describe the features and characteristics of power semiconductor devices.
			CO2	Analyze and design triggering, commutation and protection circuits.
			CO3	Illustrate, analyze and design AC-DC converters.
			CO4	Illustrate, analyze and design DC-DC converters.
			CO5	Illustrate, analyze and design-AC converters.
			CO6	Illustrate, analyze and design AC-AC converters.

ELC 702	**IOT -PCK**	**CO1**	Understand concepts, functional blocks and communication methodology relevant to IoT
		CO2	Identify various components of IoT
		CO3	Compare various communication protocols for IoT
		CO4	Understand various methods for data handling in IoT-based systems
		CO5	Design basic applications based on IoT using specific components.
		CO6	Introduce various security issues in IoT
ELDO701	**DOC3 ANT-RBW**	**CO1**	Analyze the performance of networks.
		CO2	Determine the network performance using monitor tools
		CO3	Set up WLAN,PAN
		CO4	Explain optical networking technology
		CO5	Understand ATM working principle
		CO6	Understand different Networking Topologies and Network management
ELDO702	**DOC4-WC AAD**	**CO1**	1. Understand the key concepts of basic cellular system and the design requirements.
		CO2	2. Derive the various mobile radio propagation models.
		CO3	3. Analyze various multiple access techniques for wireless communication.
		CO4	4. Evaluate the performance of recent wireless technologies.
		CO5	5. Acquire the knowledge about GSM cellular concept and analyse its services and features.
		CO6	6. Analyse different technologies used for wireless communication systems and standards
ELIO701	**IOC1 CSL-VBG**	**CO1**	Understand the concept of cyber crime and its effect on outside world
		CO2	Interpret and apply IT law in various legal issues
		CO3	Distinguish different aspects of cyber law
		CO4	Apply Information Security Standards compliance during software design and development
ELL701	**PEL-MBL**	**LO1**	Describe the features and characteristics of power semiconductor devices.
		LO2	Analyze and design triggering, commutation and protection circuits.
		LO3	Illustrate, analyze and design AC-DC converters.
		LO4	Illustrate, analyze and design DC-DC converters.
		LO5	Illustrate, analyze and design-AC converters.
		LO6	Illustrate, analyze and design AC-AC converters.
ELL702	**IOTL-PCK**	**LO1**	Interface various sensors to any IoT device and push data onto cloud
		LO2	Remotely control various devices using Blynk App and Node-red environment.
		LO3	Implement IoT protocols to control devices remotely.
		LO4	Implement services like Google Assistance, Adafruit I/O, IFTTT, Firebase etc in IoT
		LO5	Configure AWS Cloud and its Application in IoT
ELL703	**DOC3L-**	**LO1**	Analyse the Wi-Fi Communication networks

		ANTL	LO2	Implement network security management tools
			LO3	Implement networking tools using Linux.
			LO4	Evaluate network performance based on various metrics.
			LO5	Design and configure DHCP Protocol
			LO6	Design and Study Optical network
	ELP701	MP1-RBC	LO1	Identify problems based on societal /research needs.
			LO2	Apply Knowledge and skill to solve societal problems in a group
			LO3	Develop interpersonal skills to work as member of a group or leader
			LO4	Analyze the impact of solutions in societal and environmental context for sustainable development.
			LO5	Use standard norms of engineering practices
			LO6	Demonstrate project management principles during project work
SEM VIII	ELC801	IA-RBW	CO1	Describe automation, need, importance and applications in industry
			CO2	Develop PLC programs using ladder instructions for the process applications
			CO3	Explain architecture of DCS, hierarchical control in DCS, programming DCS through Function Block Diagram (FBD) method.
			CO4	Describe SCADA architecture, communication in SCADA
			CO5	Explain database and alarm management system
			CO6	Recognize the need of SIS and describe risk reduction methods
	ELDO801	DOC5-WD-VAP	CO1	Design static web pages using HTML5
			CO2	Design the layout of web pages using CSS3
			CO3	Apply the concepts of client side validation and scripts to static web pages using JavaScript and ReactJS
			CO4	Build responsive web pages using front-end framework Bootstrap
			CO5	Build dynamic web pages using server side scripting
			CO6	Develop a web application using appropriate web development framework
	ELDO802	DOC6-IIOT-PCK	CO1	Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security
			CO2	Explore IoT technologies, architectures, standards and regulation
			CO3	Apply IoT Protocols for Industrial automation/applications
			CO4	Explain the need of IoT in Industrial environment & Security aspects of IoT
			CO5	Explain the new concepts for data logging and analytics
	ELIO801	IOC2-EM-SMK	CO1	Understand the concept of environmental management
			CO2	Understand the Global environment concerns
			CO3	Understand ecosystem and interdependance, food chain etc

			CO4	Understand the scope of environment management
			CO5	Understand and interpreet environment related legislation
	ELL801	IAL-RBW	LO1	Describe automation, need, importance and applications in industry and designproportional, integral and derivative controller
			LO2	Develop PLC programs using LD instructions for any batch process application
			LO3	Use Function Block Diagram to simulate analog and digital functions of any process
			LO4	Design graphical user interface for any SCADA applications
			LO5	Discuss the role of database, alarm management system, ERP and MES
			LO6	Recognize the need of safety instrumented system
	ELP801	MP-2-RVC	LO1	Identify problems based on societal /research needs and apply Knowledge and skill to solve societal problems in a group
			LO2	Develop interpersonal skills to work as a member of a group or leader and draw the proper inferences from available results through theoretical/ experimental/simulations.
			LO3	Analyze the impact of solutions in societal and environmental context for sustainable development and use standard norms of engineering practices
			LO4	Excel in written and oral communication.
			LO5	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
			LO6	Demonstrate project management principles during project WORK