TERNA ENGINERING COLLEGE
MECHATRONICS DEPARTMENT

SEM I	SUBJECT CODE	SUBJECT	CO/LO	CO / LO STATEMENT
SEM III	MTC301	Engineering Mathematics-III	CO1	Apply the concept of Laplace transform to solve the real integrals in engineering problems.
			CO2	Apply the concept of inverse Laplace transform of various functions in engineering problems.
			CO3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
			CO4	Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
			CO5	Apply Matrix algebra to solve the engineering problems.
			CO6	Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations
	MTC302	Data Structures and Algorithms	CO1	Implement various operations using linear data structures.
			CO2	Apply concepts of Trees and Graphs to a given problem.
			CO3	Analyse time and space complexity of an algorithm.
			CO4	Apply divide and conquer strategy to solve problems.
			CO5	Apply the concept of Greedy and Dynamic Programming approach to solve problems.
			CO6	Apply the concept of backtracking, branch and bound strategy to solve problems.
	MTC303	Engineering Materials and Metallurgy	CO1	Distinguish different types of materials and composites used in manufacturing.
			CO2	Select a material for specific applications
			CO3	Read and interpret Iron-Iron Carbide phase diagram, TTT diagram and CCT diagram.
			CO4	Demonstrate a deeper understanding of materials in engineering applications.
			CO5	
			CO6	
	MTC304	Basic Electronics and Digital Circuit Design	CO1	Illustrate working of Transistors & its applications.
			CO2	Describe several JFET applications including switch & amplifiers.
			CO3	Describe the number system and operations of logical gates
			CO4	Design combinational digital logic circuits
			CO5	Design Sequential digital logic circuits
			CO6	Describe the testing technologies in digital electronics.
	MTC305	Electrical Circuits and Machines	CO1	Analyse and Synthesis of network theorems for DC and AC circuits
			CO2	Find two port circuits parameters
			CO3	Analyse and Synthesis R-L-C circuits in time and Frequency domain
			CO4	Illustrate working and performance characteristics of DC Motors
			CO5	Illustrate working and performance characteristics of three phase Induction Motor
			CO6	Implement systems using low power motors specially designed motors
	MTL301	Data Structures and Algorithms Laboratory	CO1	Implement various operations using linear data structures.
			CO2	Apply concepts of Trees and Graphs to a given problem.
			CO3	Analyze time and space complexity of an algorithm.
			CO4	Apply divide and conquer strategy to solve problems.
			CO5	Apply the concept of Greedy and Dynamic Programming approach to solve problems.
			CO6	Apply the concept of backtracking, branch and bound strategy to solve problems.
	MTL302	Applied Electronics Laboratory-I	CO1	Implement switching circuits using BJT, MOSFET, JFET
			CO2	Implement different LOGIC circuits
			CO3	Analyse operational characteristics of different Electrical Machines
			CO4	Simulation of Electrical Networks.
			CO5	
			CO6	
	MTL303	Electrical and Electronics Workshop	CO1	Understand working of different lab equipment
			CO2	Demonstrate skills in handling electrical components
			CO3	Repair and do maintenance of households appliances.
			CO4	Demonstrate PCB design and soldering skills
			CO5	Understand working of different parts of Computer
			CO6	Simulate Electrical networks using software techniques.
	MTL304	CAD – Modeling Laboratory	CO1	Illustrate basic understanding of types of CAD model creation.
			CO2	Visualize and prepare 2D modeling of a given object using modeling software.
			CO3	Build solid model of a given object using 3D modeling software.
			CO4	Visualize and develop the surface model of a given object using modeling software.
			CO5	Generate assembly models of given objects using assembly tools of a modeling software
			CO6	Perform product data exchange among CAD systems.
	MTPBL301	Mini Project-1B	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	Analyse 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 lifelong learning.
			CO9	Demonstrate project management principles during project work.
SEM -IV	MTC401	Engineering Mathematics-IV	CO1	Apply the concept of Vector calculus to evaluate line integrals, surface integrals using Green's theorem, Stoke's theorem & Gauss Divergence theorem.
			CO2	Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
			CO3	Apply the concept of Correlation, Regression and curve fitting to the engineering problems in data science.
			CO4	Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
			CO5	Apply the concept of probability distribution to engineering problems & testing hypothesis of small samples using sampling theory.
			CO6	Apply the concepts of parametric and nonparametric tests for analyzing practical problems.
	MTC402	Kinematics of Machinery	CO1	Identify various components of mechanisms
			CO2	Conduct displacement, velocity and acceleration analysis of various mechanisms
			CO3	Synthesize mechanisms to provide specific motion
			CO4	Select appropriate power transmission mechanism.
			CO5	Choose a cam profile for the specific follower motion
			CO6	
	MTC403	Thermal and Fluid Engineering	CO1	Demonstrate understanding of basic concepts of thermodynamics.
			CO2	Illustrate the physical properties and characteristic behavior of fluids.
			CO3	Illustrate dimensional analysis for model and similitudes.
			CO4	Identify & explain the three modes of heat transfer (conduction, convection and radiation) with mathematical model
			CO5	Design and analyze different heat exchangers
			CO6	Demonstrate basic understanding of turbines and IC engines.
	MTC404	Strength of Materials	CO1	Demonstrate fundamental knowledge about various types of loading and stresses induced.
			CO2	Draw the SFD and BMD for different types of loads and support conditions.
			CO3	Analyse the bending and shear stresses induced in beam.
			CO4	Analyse the deflection in beams and stresses in shaft.
			CO5	Analyse the stresses and deflection in beams and Estimate the strain energy in mechanical elements.
			CO6	Analyse buckling phenomenon in columns.
	MTC405	Application of 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	Analyze the various applications and circuits based on particular NON linear integrated circuit.
			CO4	Select and use an appropriate integrated circuit to build a given application.
			CO5	Design an application with the use of integrated circuit
			CO6	Design an application with the use of voltage regulator
			CO1	Characterize op-amp

	Code	Course	CO	Description	
	MTC406	Applied Electronics Laboratory-II	CO2	Design and test of various op amp circuits.	
			CO3	Do time domain characterization of system.	
			CO4		
			CO5		
			CO6		
	MTL407	Material Testing Laboratory	CO1	Understand the procedure used to prepare metallic samples for studying its microstructure	
			CO2	Identify effects of heat treatment on microstructure of medium carbon steel and hardenability of steel using Jominy end Quench test	
			CO3	Perform Fatigue Test and draw S-N curve	
			CO4	Perform Tension test to analyse the stress - strain behaviour of materials	
			CO5	Measure torsional strength, hardness and impact resistanceof the material	
			CO6	Perform flexural test with central and three point loading conditions	
	MTL408	Thermal and Fluid Engineering La	CO1	Verify the Bernoulli's principle and calibration venturimeter / orificemeter.	
			CO2	Calculate friction factor & different losses in the pipe flow	
			CO3	Estimate thermal conductivity of metals/non-metals.	
			CO4	Compute heat transfer coefficient in natural as well forced convection	
			CO5		
			CO6		
	MTL409	Technical Computing Laboratory	CO1	Import , manipulate and graphically represent data.	
			CO2	Perform basic engineering calculations using automated tools.	
			CO3	Apply programming for modeling engineering systems.	
			CO4	Manipulate and visualize complex data.	
			CO5		
			CO6		
	MTL410	Machine Shop Practice	CO1	Know the specifications, controls and safety measures related to machines and machining operations.	
			CO2	Use the machines for making various engineering jobs.	
			CO3	Perform various machining operations	
			CO4	Perform Tool Grinding	
			CO5	Perform welding operations	
			CO6		
SEM -V	MTC501	CAD and CAE	CO1	Identify proper computer graphics techniques for geometric modelling.	
			CO2	Transform, manipulate objects and store and manage data.	
			CO3	Create and manipulate 3D Models based on Medical imaging data.	
			CO4	Perform design analysis.	
			CO5	Identify the tools for Analysis of a complex engineering component.	
			CO6	Demonstrate understanding of design optimization.	
	MTC502	Sensors and Actuators	CO1	Identify sensor characteristics including calibration and error analysis	
			CO2	Implement common techniques of signal conditioning	
			CO3	Understand how different physical variables are measured and illustrate their working principles	
			CO4	Identify different types of actuators and their implementation	
			CO5	Understand new technologies of actuation	
			CO6	Identify and select sensors and actuators for industrial applications	
	MTC503	Mechatronic Systems Modelling an	CO1	Define a first principle model of a Mechatronic system	
			CO2	Define the open loop and closed loop system	
			CO3	Design time response of first and second order system and basic state variable analysis	
			CO4	Sketch the frequency response of second order systems using polar plot and bode plots.	
			CO5	Design a compensator to stabilize the unstable system.	
			CO6		3
	MTC504	Embedded Systems	CO1	Describe the Components, importance and applications of embedded system	
			CO2	Describe architecture, interface peripherals and program 8051 microcontrollers	
			CO3	Describe architecture, interface peripherals and program ARM7 microcontrollers	
			CO4	Illustrate basic terminologies of software development and real time operating system	
			CO5	Design microcontroller based embedded systems for various applications	
			CO6		
	MTC505	Production Processes	CO1	Demonstrate understanding of casting process	
			CO2	Illustrate principles of forming processes.	
			CO3	Demonstrate applications of various types of welding processes.	
			CO4	Differentiate chip forming processes such as turning, milling, drilling, etc.	
			CO5	Illustrate the concept of producing polymer components and ceramic components.	
			CO6	Illustrate principles and working of non-traditional and electronic manufacturing	
	MTC506	Operating Systems	CO1	Understand the basic concepts related to Operating Systems.	
			CO2	Describe the process management policies and illustrate scheduling of processes by CPU.	
			CO3	Explain and apply Inter-process Communication (IPC) and evaluate deadlock conditions	
			CO4	Illustrate the memory & Describe the memory and file management	
			CO5	Describe Architecture of RTOS & its Implementation with application	
			CO6	Select Appropriate OS for interdisciplinary applications	
	MTL501	Sensors and Actuators Laboratory	CO1	Measure different physical variables for Mechatronic applications.	
			CO2		3
			CO3	Identify and select proper sensors for specific applications	
			CO4	Interfacing different types sensors and actuators	
			CO5	Design and implement systems using sensors and actuators	
			CO6		
	MTL502	Mechatronic Systems Modelling an	CO1	Model and simulate physical systems using software tools	
			CO2	Perform Parameter Identification	
			CO3	Define the open loop and closed loop system	
			CO4	Simulate time and frequency response of first and second order systems.	
			CO5	Simulate the control system for getting different response.	
			CO6	Design of controller for position/velocity control of DC Motor	
	MTL503	Professional Communication and E	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 organizationalbehaviour.	
	MTPBL501	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	Analyse 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.	
	MTC601	Digital Manufacturing	CO1	Analyze impact of digitalization on manufacturing	
			CO2	Demonstrate understanding of NC and CNC technology for subtractive manufacturing	
			CO3	Implement manual part programming for CNC Machines	
			CO4	Understand and apply computer aided part programming	
			CO5	Analyze and compare various technologies used in additive manufacturing	
			CO6	Explain industrial revolutions and technologies important for Industry 0	
			CO1	Discuss tradeoffs involved in power semiconductor switches	

	Subject Code	Subject Name	CO	Description
			CO2	Analyze different types of power converters.
			CO3	Analyze issues involved in controlling of AC and DC drives.
			CO4	Realize drive considerations for different industrial applications.
			CO5	
	MTC602	Power Electronics and Drives	CO6	
			CO1	Demonstrate understanding of fundamentals of process control
			CO2	Select proper transmitter for different parameters
			CO3	Use suitable valves and actuators for different situations
			CO4	Design controller for different processes and applications
			CO5	Tune PID Controllers
	MTC603	Instrumentation and Control	CO6	Write the ladder diagram programs for discrete process control industrial applications.
			CO1	Analyze fluid power system
			CO2	Describe construction and working of hydraulic components
			CO3	Design hydraulic system.
			CO4	Describe construction and working of pneumatic components
			CO5	Design pneumatic system.
	MTC604	Applied Hydraulics and Pneumatic	CO6	3
			CO1	Identify appropriate microfabrication process for development of functional microsystem.
			CO2	Apply knowledge of microfabrication techniques to the design and develop a microsystem.
			CO3	Understand the working principle of different microfabrication processes
			CO4	
			CO5	
	MTDO601	Microfabrication Processes	CO6	
SEM-VI			CO1	Explain the psychopathology of user interface design
			CO2	Design innovative and user friendly interfaces for industrial application.
			CO3	Criticize existing interface designs, and improve them.
			CO4	Design application for social and technical task with safety concern.
			CO5	
	MTDO602	Machine Interface Design	CO6	
			CO1	Understand basic concepts in python.
			CO2	Independently write code in Python, to be able to find python packages, install and utilize them
			CO3	Understand how real world engineering problems can be solved and understood using Python
			CO4	Draft and prepare case studies and report
			CO5	
	MTL601	Python Programming Laboratory	CO6	
			CO1	Characterization of Instruments used in process control
			CO2	Implementation of PID controller and its variations
			CO3	Implement PLC programming for process
			CO4	Implementation of DC Motor Drives
			CO5	Implement of AC Motor Drives
	MTL602	Instrumentation and Electric Drive	CO6	
			CO1	Design pneumatic and electro-pneumatic system for industrial application.
			CO2	Design hydraulic and electro-hydraulic system for industrial application.
			CO3	Characterization of Hydraulic system components
			CO4	Selection of Hydraulic and Pneumatic System components
			CO5	
	MTL603	Applied Hydraulics and Pneumatic	CO6	
			CO1	Demonstrate CAM Tool path and prepare NC- G code.
			CO2	Apply rapid prototyping and tooling concepts for any real life applicationsn
			CO3	Convert 2D images into 3D model
			CO4	
			CO5	
	MTL604	CNC and 3-D Printing Laboratory	CO6	
			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	Analyse the impact of solutions in societal and environmental context for sustainable development.
			CO6	Use standard norms of engineering practices
			CO7	7. Excel in written and oral communication.
			CO8	8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
	MTPBL601	Mini Project-2B	CO9	9. Demonstrate project management principles during project work.
			CO1	Explain Vehicle architecture and Electronic Control units
			CO2	Explain electronic transmission control and its types
			CO3	Explain working of Driving assistance systems such as Active Steering, Antilock braking, Traction control and electronic stability program
			CO4	Explain working of adjustment systems and fault diagnostics
			CO5	Demonstrate understanding of basic principles of vehicular networking and communication
	MTC701	Automotive Mechatronics	CO6	Explain electric vehicles and autonomous vehicles
			CO1	Explain Design Process, structure, elements and application of Mechatronics
			CO2	Modelling and simulation of Mechatronic system including system identification
			CO3	Implement Servo control and controller tuning.
			CO4	Actuator selection and drive train design for motion control applications
			CO5	Motion control programming for industrial applications
	MTC702	Design of Mechatronic Systems	CO6	Indigenously design and develop a mechatronic system.
			CO1	Analyze and appreciate the applications which can use Neural Network and fuzzy logic.
			CO2	Identify and describe NNFL techniques and their roles in building intelligent machines.
			CO3	Design inference systems for decision making in manufacturing industries.
			CO4	Realize the difference between learning and programming and explore practical applications of Neural networks (NN).
			CO5	Demonstrate the use of Neuro-fuzzy network for various industry applications.
	MTDLO7032	Neural Network and Fuzzy Logic		
			CO1	Select proper electrodes and electrolyte for different measurement of parameters
			CO2	Explain the principle and working of any biomedical equipment
			CO3	Design suitable orthotic and prosthetic devices and applications
			CO4	Explain the working of different imaging techniques in Biomedical Engineering
			CO5	Explain technological aspects of robotic surgery.
	MTDLO7042	Medical Mechatronics	CO6	Demonstrate the significance of safety, telemetry in biomedical Instrumentation
			CO1	Implement battery charging / management
			CO2	Communicate with sensors and actuators using CAN Bus
			CO3	Implement and characterize automotive sensor and actuator
			CO4	Implement automatic transmission.
			CO5	Implement Automotive Mechatronic system.
SEM VII	MTL701	Automotive Mechatronics Lab		
			CO1	Perform Modelling and simulation of Sensors and Actuators
			CO2	Perform Interfacing of sensors and actuators with control hardware
			CO3	Perform Mechatronic system development

	MTL702	Mechatronics Lab		
			CO1	Implement fuzzy controller for electromechanical systems
			CO2	Implement Supervised and Unsupervised Learning algorithms
		Neural Network and Fuzzy Logic		
	MTL7032	Laboratory		
			CO1	Students will be able to develop the understanding of the problem domain through extensive review of literature.
			CO2	Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
			CO3	Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
			CO4	Students will be able to design solutions for real-time problems that will positively impact society and environment..
			CO5	Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
	MTP701	Major Project I	CO6	Students will be able to inculcate professional and ethical behavior..
SEM VIII			CO1	Identify opportunities for automation in manufacturing
			CO2	Plan design and implement automation systems
			CO3	Program industrial controller for automation application
			CO4	Explain scope and benefit of industry 0 technologies
		Industrial Automation and		
	MTC801	Industry 4.0		
			CO1	Understand the concepts of IoT and building blocks of IoT.
			CO2	To elaborate the principles and process involve in Industrial IoT.
			CO3	To identify the required protocols, tools and frameworks for Industrial IoT.
			CO4	To analyze the impact of Industrial IoT-based applications.
			CO5	To explore the different challenges associated with deployment of Industrial IoT.
	MTDLO8051	Industrial IOT		
			CO1	Select robot for industrial task and identify areas in which robot can be deployed in industry.
			CO2	Program wheeled mobile robots for industrial tasks.
			CO3	Select, deploy and program industrial robot arms for industrial tasks.
			CO4	Develop skills in machine vision
			CO5	Develop skills in applying machine vision for robot control.
	MTDLO8061	Robotics and Machine Vision		
			CO1	Understand and appreciate the basics of managerial concepts and practices used in day to day practices in organizations.
			CO2	Creating organization structure and use insight to make more effective decisions
			CO3	Appreciate the need to prepare oneself for holistic thinking and effectively managing organizations.
			CO4	Develop competency in project management.
		Engineering Management and	CO5	Understand economics and correlate economic concepts.
	MTDLO8063	Economics	CO6	Understand and apply basic financial management in industrial context.
			CO1	Understand the concept of business plan and ownerships
			CO2	Interpret key regulations and legal aspects of entrepreneurship in India
			CO3	Understand government policies for entrepreneurs
		Entrepreneurship Development		
	ILO8023	and Management		
			CO1	Program and control mobile robots
			CO2	Program and control robotic manipulators
			CO3	Implement basic image processing
			CO4	Design and implement robotic system.
		Robotics and Machine Vision		
	MTL801	Laboratory		
			CO1	Mechanical design and assembly of automation systems
			CO2	Design control panel and perform electrical wiring
			CO3	Interfacing and control of PLC based automation systems
			CO4	Develop automation systems with Industry 0 technologies
		Industrial Automation and		
	MTL802	Industry 4.0 Lab		
			CO1	Students will be able to implement solutions for the selected problem by applying technical and professional skills.
			CO2	Students will be able to analyze impact of solutions in societal and environmental context for sustainable development.
			CO3	Students will be able to collaborate best practices along with effective use of modern tools.
			CO4	Students will be able to develop proficiency in oral and written communication with effective leadership and teamwork.
			CO5	Students will be able to nurture professional and ethical behavior.
	MTP801	Major Project II	CO6	Students will be able to gain expertise that helps in building lifelong learning