ANNEXURE – I – COURSE OUTCOMES AND CO-PO MAPPING

22NES408	**ELECTRICAL MACHINES**	**IV**
COURSE OUTCOMES: At the end of the course, the students will have the ability to:		**PO's Mapped**
CO1	Explain the fundamental principles, construction, working, and characteristics of DC machines, transformers, and AC machines (induction and synchronous machines).	-
CO2	Apply electrical machine principles and equivalent circuit concepts to compute performance parameters such as efficiency, losses, voltage regulation, torque, and speed.	PO1
CO3	Analyze the behaviour and performance of DC machines, transformers, induction motors, and synchronous machines under various operating conditions.	PO2
CO4	Design and select suitable electrical machines and starting, control, and protection methods for given industrial and domestic applications.	PO3
CO5	Simulate and evaluate the performance characteristics of electrical machines using simulation tools and interpret the results.	PO5
CO6	Work in teams to study, analyze, and present a mini project related to electrical machines and their applications.	PO8, PO9, PO10

COURSE ARTICULATION MATRIX:

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO2	3	-	–	–	–	–	–	–	–	–	–	3	–	–
CO3	–	3	–	-	–	–	–	–	–	–	–	3	–	–
CO4	–	–	3	–	–	–	–	–	–	–	–	3	3	–
CO5	–	–	–	–	3	–	–	–	–	–	–	3	–	3
CO6	–	–	–	–	–	–	–	3	3	3	–	–	3	3
22NES408	3	3	3	-	3	–	–	3	3	3	–	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial														

22NPC407	**ELECTRONICS FOR ANALOG SIGNAL PROCESSING**	**IV**
COURSE OUTCOMES: At the end of the course, the students will have the able to:		**PO's Mapped**
CO1	Explain the basic principles of IC fabrication, internal structure and characteristics of operational amplifiers, special ICs, and fundamental concepts of ADC and DAC systems.	-
CO2	Apply operational amplifier concepts to analyze and solve problems related to linear and non-linear op-amp applications, waveform shaping circuits, and basic data conversion techniques.	PO1
CO3	Analyze the performance of Op-amp circuits, comparators, active filters, oscillators, waveform generators, timer circuits, voltage regulators, and ADC/DAC architectures under different operating conditions.	PO2
CO4	Design op-amp based signal processing circuits, waveform generators, timer circuits, and data converter systems to meet given specifications and practical requirements.	PO3

CO5	Simulate using Simulation-based tools to investigate the behavior of op-amp circuits, special ICs, and ADC/DAC systems.	PO5, PO6 PO8, PO9
CO6	Present seminars/case studies/projects on recent developments and advanced applications of operational amplifiers, special ICs, and data conversion techniques to enhance professional and lifelong learning skills.	PO7, PO8 PO9, PO10 PO11

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	3	2	-	3	3	-	-	3	-	2
CO6	-	-	-	-	-	-	3	3	3	2	3	3	-	2
22NPC407	3	3	3	-	3	2	3	3	3	2	3	2.6	-	2

22NPC408	**DIGITAL ELECTRONICS**	**IV**
COURSE OUTCOMES: At the end of the course, the students will have the able to:		**PO's Mapped**
CO1	**Explain** the fundamental concepts of number systems, Boolean algebra, logic gates, combinational circuits, sequential circuits, memory devices and the basic elements of VHDL.	-
CO2	**Apply** Boolean algebra, Karnaugh map techniques, combinational and sequential logic principles to compute and realize logic functions and digital circuits.	PO1
CO3	**Analyze** the behavior and performance of combinational, synchronous and asynchronous sequential circuits.	PO2
CO4	**Design** combinational and sequential digital systems using appropriate logic elements.	PO3
CO5	**Simulate** and evaluate digital circuits using HDL tools or any other simulation tools and interpret results.	PO5
CO6	Work in teams to implement and present a mini project on a digital system.	PO8, PO9, PO10, PO11

COURSE ARTICULATION MATRIX:														
CO and PO Mapping:														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	-	-	3	3	3	3	-	-	-
22NPC408	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial														

22NPC409	**INDUSTRIAL INSTRUMENTATION**	**IV**
COURSE OUTCOMES Upon Completion of the course, the students will be able to		POs Mapped
CO1	Explain the principles, terminology, classifications, working concepts, and characteristics of industrial measurement systems used for temperature, pressure, flow, level, viscosity, humidity, moisture, and densitymeasurements.	-
CO2	Applyfundamental knowledge of mathematics, science, andengineering principles tocompute measurement parameterssuch as flow rate, pressure, temperature, and level using standard industrial instrumentation methods.	PO1
CO3	Analyzethe existingindustrial measurement problems by identifying sources of error, limitations,and selection of sensors for specific industrial applications.	PO2
CO4	Designappropriate instrumentation systems by selecting sensors, andtransmitters forreal-time industrial measurement applications**,** considering accuracy, reliability, safety, and operatingconditions.	PO3
CO5	Evaluatethe performance of industrial instruments by applying modern engineering tools and simulation software	PO4, PO5, PO6
CO6	Communicate technical information effectively and present industrial instrumentation solutions, including sensor selection, safety considerations, and transmitter integration, within realistic industrial constraints.	PO8, PO9, PO11

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3		-	-	-	-	-	-	-	-	-	-	3	2
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-	3	2
CO5	-	-	-	3	3	3	-	-	-	-	-	-	3	2
CO6	-	-	-	-	-	-	-	3	3	-	3	-	3	2
22NPC 409	3	3	3	3	3	3		3	3		3		3	2

22NPC410	FUNDAMENTALS OF SIGNALS AND SYSTEMS	IV
COURSE OUTCOMES: Upon Completion of the course, the students will be able to		**PO's Mapped**
CO1	**Explain** the fundamental concepts of continuous-time and discrete-time signals and systems, their classification, system properties and analysis using transform techniques.	
CO2	**Apply** sampling theory concepts to discretize continuous-time signals, analyze aliasing effects, quantization errors, and reconstruct signals using interpolation techniques.	PO1
CO3	**Analyze** continuous-time signals using time-domain techniques and frequency domain techniques include Fourier series, Fourier transform, and interpret spectral characteristics.	PO2
CO4	**Design** discrete-time systems using Z-transform techniques with respect to stability, causality, and realizability, and compute inverse Z-transforms.	PO3, PO4
CO5	**Simulate** using Software tools to experiment Fourier and Z transforms for continuous and discrete signals and systems	PO3, PO5,
CO6	**Present Seminar** in signal processing concepts and transform techniques and system models, and demonstrate independent learning	PO9, PO11,

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	-	–	–	–	–	–	–	–	–	–	–	-	–	–
CO2	3	-	–	–	–	–	–	–	–	–	–	3	-	–
CO3	–	3	–	–	–	–	–	–	–	–	–	3	-	–
CO4	–	–	3	2	–	–	–	–	–	–	–	3	1	2
CO5	–	–	2	–	3	–	–	–	–	–	–	-	1	3
CO6	–	–	–	-	-	–	–	–	3	-	2	-	-	3
22NPC410	**3**	**3**	**2.5**	**2**	**3**	**-**	**-**	**-**	**3**	**-**	**2**	**3**	**1**	**2.6**

22NPC411	ANALOG AND DIGITAL CIRCUITS LABORATORY	IV
COURSE OUTCOMES: Upon Completion of the course, the students will be able to		**PO's Mapped**
CO1	**Explain** the principles and operation of basic digital and analog electronic circuits implemented in the laboratory	
CO2	**Apply** Boolean logic concepts to implement combinational and sequential circuits using logic gates and electronic circuit concepts to implement using required ICs.	PO1
CO3	**Analyze**the performance of digital and analog circuits such as flip-flops, counters, amplifiers, filters, and converters through experimental observations.	PO2
CO4	**Design** and implement digital and analog electronic circuits to meet given functional specifications.	PO3
CO5	**Simulate** electronic circuits using appropriate software tools and compare simulated results with experimental outcomes.	PO5
CO6	Work effectively in a **team** to perform experiments by following safety procedures, analyze results, and present observations in the form of records	PO6, PO7, PO8, PO9,PO10

COURSE ARTICULATION MATRIX:														
CO and PO Mapping:														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	3	3	3	3	3	-	-	-	-
22NPC411	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial														

22NPC412	VIRTUAL INSTRUMENTATION LABORATORY	VI
COURSE OUTCOMES Upon Completion of the course, the students will be able to		POs Mapped
CO1	Explain the basic concepts, terminology, programming elements, and functional blocks of virtual instrumentation systems**,** including VIs, sub-VIs, loops, arrays, clusters.	-
CO2	Apply modular and structured virtual instrumentation program techniques usingsub-VIs, FOR/WHILE loops, and structuresfor engineering applications.	PO1
CO3	Analyze the signals acquired using DAQ, ELVIS and Embedded kit.	PO2
CO4	Design signal conditioning circuits for real-time measurement applications.	PO3
CO5	Investigate modern virtual instrumentation tools and platformsto design control systems for real-time applications, and validate	PO4, PO5, PO6

	resultswhile considering safety, environmental impact,sustainability, and societal relevance of virtual instrumentation–based measurement systems.	
CO6	Work effectively in a **team** to perform experiments by following safety procedures, analyze results, and present observations in the form of records	PO6, PO7, PO8, PO9,PO11

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	-	-	-	1	2	2
CO2	3		-	-	-	-	-	-	-	-	-	1	2	2
CO3	-	3	-	-	-	-	-	-	-	-	-	1	2	2
CO4	-	-	3	-	-	-	-	-	-	-	-	1	2	2
CO5	-	-	-	3	3	3	-	-	-	-	-	1	2	2
CO6	-	-	-	-	-	3	3	3	3	-	3	1	2	2
22NP C 412	3	3	3	3	3	3	3	3	3		3	1	2	2

22NPC621	**PROCESS DYNAMICS AND CONTROL**	**VI**
COURSE OUTCOMES: At the end of the course, the students will have the ability to:		**PO's Mapped**
CO1	Explain the basic principles, terminology, components and block diagrams for diverse industrial process control systems	-
CO2	Apply the concepts of mathematical modelling, controller design and tuning, to implement control actions in a final control element for a given industrial process.	PO1
CO3	Analyze the dynamics of process, evaluate the effect of different controller structures, tuning techniques, and different final control elements.	PO2
CO4	Design and implement suitable controllers with appropriate tuning methods to achieve desired control actions in the final control element of a given industrial process.	PO3
CO5	Simulate the dynamics of processes, controllersusing different tuning techniquesfor real-world scenarios	PO5
CO6	Present a Seminar/Case Study/Miniprojecton evaluation of the advanced control schemes for various industrial processesconsidering environmental and industrial safety.	PO7,PO8, PO9, PO10 PO11

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3		-	-	-	-	-	-	-	-	-	-	2	2
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	-	-	-	-	3	-	-	-	-	-	-	-	2	2
CO6	-	-	-	-	-	-	3	3	3	3	3	-	2	2
22NPC 621	3	3	3	-	3	-	3	3	3	3	3	-	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

22NPC622	**INDUSTRIAL CONTROL SYSTEMS**	**VI**
COURSE OUTCOMES At the end of the course, students will be able to		PO's Mapped
CO1	Explain the structure and operation of industrial control systems by integrating PLC architecture and programming, industrial communication buses and protocols, SCADA and HMI components, and Distributed Control System architectures used in modern industries.	-
CO2	**Apply** industrial control system concepts including PLC programming, industrial networking, SCADA/HMI supervision, and DCS architecture to automate and monitor industrial processes.	PO1
CO3	**Analyze** PLC, fieldbus, SCADA/HMI, and DCS architectures to determine their suitability, performance, and limitations for discrete and continuous industrial process automation applications	PO2
CO4	Design PLC-based control program by selecting appropriate PLC hardware and programming strategies using ladder logic, timers, counters, sequencing, and control functions to automate a given application	PO3
CO5	Designan integrated industrial control solutions by selecting appropriate PLC architectures, programming strategies, industrial communication and fieldbus protocols, SCADA/HMI supervisory structures, and DCS architectures using automation simulation tools to meet the automation, monitoring, and control requirements of discrete and continuous industrial processes through Case studies/Mini Projects.	PO5, PO6, PO8, PO9, PO11
CO6	Present a seminar on troubleshooting issues related to PLC installation and programming, communication failures, SCADA alarms, and DCS process interfacing problems along with emerging trends in Industrial Control Systems.	PO8, PO9, PO11

	COURSE ARTICULATION MATRIX:													
	CO and PO Mapping:													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	1	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	3
CO3	-	3		-	-	-	-	-	-	-	-	-	2	3
CO4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
CO5	-	-	-	-	3	-	-	2	3	-	2	-	3	3
CO6	-	-	-	3	-	3	-	2	3	-	2	-	-	3
22NPC622	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**2**	**3**	**-**	**2**	**-**	**2**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial													

22NPC623	**BASICS OF VLSI DESIGN**	**VI**
COURSE OUTCOMES At the end of the course, students will be able to		PO's Mapped
CO1	**Explain** the fundamentals of VLSI design, Physical and electrical characteristics of CMOS circuits and networks and testing of VLSI systems.	-

CO2	**Apply** CMOS circuit techniques to draw stick diagrams, layout diagrams, compute DC characteristics, delay and power dissipation of basic, complex logic gates and clock circuits	PO1
CO3	**Analyze** clocking schemes and memories, performance of CMOS inverters and high-speed logic networks under different loading and operating conditions.	PO2
CO4	**Design**and develop CMOS circuits and high speedlogic networks using suitable modeling techniques.	PO3
CO5	**Simulate** and evaluate VLSI circuits and subsystems using appropriate EDA tools and interpret timing and power results.	PO4, PO5
CO6	Engage in **self-learning** to study recent trends in VLSI technology and present findings considering cost and societal impact.	PO6, PO10, PO11

COURSE ARTICULATION MATRIX:														
CO and PO Mapping:														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	1	3	-	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	1	-	-	-	1	3	-	-	-
22NPC623	**3**	**3**	**3**	**1**	**3**	**1**	**-**	**-**	**-**	**1**	**3**	**3**	**-**	**-**
1 – Slight, 2 – Moderate, 3 – Substantial														

22NPC624	**PROCESS CONTROL LABORATORY**	**VI**
COURSE OUTCOMES: At the end of the course, the students will have the ability to:		**PO's Mapped**
CO1	Explain the procedures for measuring and controlling the industrial process parameters such as Flow, Level, Pressure and Temperature.	-
CO2	Analyze the open-loop and closed-loop dynamic responses of various process control systems (e.g., level, flow, temperature) using experimental data.	PO1
CO3	**Apply** and **evaluate** appropriate controller tuning methods (e.g., Ziegler-Nichols, Cohen-Coon) to achieve desired performance specifications for process system.	PO2
CO4	Design and implement a complete control system for a multi-variable process like Cascade control, Feed-Forward control and MIMO process using modern software and hardware tools, and justify the design choices.	PO3
CO5	Communicate effectively by preparing clear and concise engineering reports to document experimental procedures, results, and conclusions	PO8, PO9 PO11
CO6	Work effectively in teams to plan, implement, and demonstrate control solutions for the real time processes.	PO8, P011

COURSE ARTICULATION MATRIX :

COs/ POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	3
CO4	-	-	3	-	-	-	-	-	-	-	-	-	2	3
CO5	-	-	-	-	-	-	-	3	3	-	3	-	2	3
CO6	-	-	-	-	-	-	-	3	-	-	3	-	2	3
22NPC 624	3	3	3	-	-	-	-	3	3	-	3	-	2	3
1 – Slight, 2 – Moderate, 3 – Substantial														

22NPC625	**INDUSTRIAL CONTROL SYSTEMS LABORATORY**	**VI**
COURSE OUTCOMES At the end of the course, students will be able to		PO's Mapped
CO1	**Apply** PLC programming concepts to develop and execute PLC programs for discrete and continuous industrial processes such as bottle filling, traffic light control, lift control etc.,	PO1, PO5
CO2	Analyze analog/digital field devices and configure and interface using AI, AO, DI, DO modules with industrial PLC and DCS systems, and validate signal acquisition	PO2, PO5
CO3	Develop feedback control strategies and implement speed control of motors and process control loops for flow/level systems using PLC/DCS-based control and monitoring.	PO3, PO5
CO4	Design and implement SCADA/HMI applications for industrial process stations involving real-time monitoring, alarm handling, trend visualization, and operator interaction for parameters such as flow, level, pressure, and temperature.	PO4, PO5
CO5	Work effectively in teams to plan, implement, and demonstrate PLC/DCS/SCADA/IoT-based control solutions for the industrial automation problems.	PO8, PO11
CO6	Demonstrate effective communication skills by documenting industrial control system experiments through technical reports and presenting PLC/DCS/SCADA implementation, results, and conclusions using appropriate engineering terminology and visuals.	PO9, PO11

	COURSE ARTICULATION MATRIX:													
	CO and PO Mapping:													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	-	-	-	3	-	-	-	-	-	-	-	2	3
CO2	-	3	-	-	3	-	-	-	-	-	-	-	2	3
CO3	-	-	3	-	3	-	-	-	-	-	-	-	2	3
CO4	-	-	-	3	3	-	-	-	-	-	-	-	2	3
CO5	-	-	-	-	-	-	-	3	-	-	3	-	2	3
CO6	-	-	-	-	-	-	-	-	3	-	3	-	-	3

22NPC625	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**2**	**3**
	1 – Slight, 2 – Moderate, 3 – Substantial													

22NES609	**DESIGN THINKING FOR INSTRUMENTATION ENGINEERING**	**VI**
COURSE OUTCOMES At the End of the course, the students will have the ability to		**POs Mapped**
CO1	Explain the principles, need, objectives, concepts, and stages of the Design Thinking process, including creative thinking and problem-solving methodologies, with suitable real-world examples.	
CO2	Apply the concepts of Design Thinking and creative problem-solving techniques to identify user needs, define problem statements, and generate feasible solution ideas for real-world engineering problems.	PO1,
CO3	Analyze real-world problems through field visits by identifying stakeholders, target customers, constraints, and use cases, and evaluate alternative solution approaches.	PO2,
CO4	Design an engineering product or system by following the Design Thinking approach, including ideation, conceptualization, and development of a proof-of-concept or minimum usable product.	PO3,
CO5	Simulate or demonstrate the functionality of the proposed solution using prototypes, models, mock-ups, or conceptual simulations to validate design assumptions and user requirements.	PO1, PO2, PO3, PO4, PO11
CO6	Present and defend the designed solution through a structured report and seminar-style pitch, effectively communicating the problem, design process, prototype, and expected impact.	PO9, PO10, PO11

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	–	–	–	–	–	–	–	–	–	–	–	**1**	–	–
CO2	**2**	–	–	–	-	–	–	–	–	–	–	**2**	**1**	**1**
CO3	–	**3**	–	–	-	–	–	–	–	–	–	**3**	**2**	**2**
CO4	–	–	**3**	–	–	–	–	–	–	–	–	**3**	**3**	**3**
CO5	**2**	**1**	**2**	**2**	–	–	–	–	–	–	**3**	**2**	**2**	**3**
CO6	–	–	–	–	–	–	–	–	**2**	**3**	**3**	**1**	**1**	**2**
Average	**2**	**2**	**2.5**	**2**	–	–	–	–	**2**	**3**	**3**	**2**	**1.8**	**2.2**

22NPE$09	**FIBER OPTICS AND LASER INSTRUMENTATION**	**VI**
COURSE OUTCOMES:		**PO's Mapped**
CO1	**Explain** the principles of light propagation in optical fibers, characteristics and types of lasers	
CO2	**Apply** optical fiber–based measurement principles for sensing and instrumentation of physical parameters and holography principles, holographic interferometry and non-destructive testing	PO1

CO3	**Analyze** the fundamental characteristics of different types of fibre optics and lasers, and resonator configurations.	PO2
CO4	**Design** laser-based material processing techniques for industrial, environmental and medical applications.	PO3, PO6
CO5	Present seminar/technical report onholography principles, holographic interferometry, non-destructive testing, and medical applications of lasers with emphasis on safety aspects	PO2, PO6, PO9, PO11
CO6	Solve engineering problems related to optical fiber and laser systems and demonstrate independent learning through assignments, case studies, and applications.	PO9, PO11

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	-	–	–	–	–	–	–	–	–	–	–	-	-	–
CO2	3	-	–	–	-	–	–	–	–	–	–	-	3	2
CO3	-	3	–	–	–	–	–	–	–	–	–	-	3	2
CO4	–	–	3	–	-	2	-	–	–	–	–	-	3	2
CO5	–	2	-	–	-	2	-	–	2	-	2	-	-	3
CO6	–	–	–	-	-	–	–	–	2	-	2	-	2	3
Average	**3**	**2.5**	**3**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**-**	**2.75**	**2.4**

22NPE$28	**INDUSTRIAL INTERNET OF THINGS**	**VI**
COURSE OUTCOMES At the End of the course , the students will have the ability to		POs Mapped
CO1	**Explain** the concepts ofdigitisation, digital transformation, cyber-physical systems, Industry 4.0 evolution**,** and theoverall role of IIoT architectures, communication technologies, analytics, and industrial applicationsin smart manufacturing and process industries.	
CO2	**Apply** ISA-95 framework, IIoT architectural concepts, sensor and actuator characteristics, industrial wireless standards, and communication protocols to map appropriate technologies to given industrial automation and monitoring use cases.	PO1
CO3	**Analyze** IIoT architectures, data analytics workflows, industrial communication protocols, and cybersecurity challenges to evaluate system performance and risks.	PO2
CO4	**Design** an IIoT-based industrial solution by integrating smart sensors/actuators, communication protocols, edge–cloud infrastructure, analytics techniques, and emerging technologies such as AR/VR for selected industrial domains.	PO3
CO5	**Simulate** IIoT data acquisition, communication, visualization, and analytics operations using IoT platforms and tools, including basic AI/ML-based industrial data processing.	PO1,PO2, PO3, PO4,PO11

CO6	**Present a technical seminar** or case study on industrial IIoT applications, such as smart factories, brownfield IoT, oil and gas, retailing, or big-data-driven value creation, demonstrating technical depth and effective communication.	PO9,PO10, PO11

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**1**	**1**	**2**
CO2	**3**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2**	**3**	**2**
CO3	**–**	**3**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2**	**2**	**3**
CO4	**–**	**–**	**3**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2**	**3**	**3**
CO5	**1**	**1**	**2**	**3**	**–**	**–**	**–**	**–**	**–**	**–**	**3**	**1**	**2**	**3**
CO6	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2**	**3**	**3**	**–**	**1**	**2**
22NPE$28	**2**	**2**	**2.5**	**3**	**–**	**–**	**–**	**–**	**2**	**3**	**3**	**1.6**	**2**	**2.5**