Final

DIPLOMA CURRICULUM OF MECHATRONICS ENGINEERING (THIRD YEAR) (5th Semester)

(To be implemented from 2026-27)

Prepared by;

National Institute of Technical Teachers' Training & Research Kolkata
Block – FC, Sector – III, Salt Lake City, Kolkata – 700106

Vetted by:
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PROGRAMME TITLE: MECHATRONICS ENGINEERING

SEMESTER – V

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme				Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam	Progressive Assessment		
1	Programme Core	MEPC301 TH:1	Robotics		3	0	0	70	30	-	-	100	3
2		MEPC303 TH:2	Industrial Automation		3	0	0	70	30	-	-	100	3
3		MEPC305 TH:3	PLC, HMI AND SCADA		3	0	0	70	30	-	-	100	3
4		MEPC307 PR:1	Robotics LAB		0	0	4	-	-	15	35	50	2
5		MEPC309 PR:2	Industrial Automation & PLC LAB		0	0	4	-	-	15	35	50	2
6		MEPC311 PR:3	Auto Cad LAB		0	0	4	-	-	15	35	50	2
7	Programme Elective	MEPE301 (Anyone) TH:4	(A). Micro Mechatronic Systems (B). Digital Signal Processing (C). Embedded System		3	0	0	70	30	-	-	100	3
8	Open Elective	OE301 (Anyone) TH:5	(A). Universal Human Values (B). Leadership and management skills (C). Professional skills		3	0	0	70	30	-	-	100	3
9	Summer Internship	SI301	SUMMER INTERNSHIP II*		0	0	0	-	-	15	35	50	2
10	Major Project	PR301 PR:4	MAJOR PROJECT		0	0	4	-	-	15	35	50	2
TOTAL					**15**	**0**	**16**	**350**	**150**	**75**	**175**	**750**	**25**

*3-4-week internship after 4th Semester.

***The best of 2 IA conducted in a subject out of 20 marks to be considered. Assignment/ quiz etc. of 10 marks to be treated as part of IA. Besides this, Monthly Test to be conducted for each subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester. Club/Innovation/ Idea Tinkering Activities etc. shall be encouraged to be performed by students beyond the above stipulated hours.**

5TH SEMESTER

TH:1- ROBOTICS					
L	T	P	Total Marks: 100	Code: MEPC301	
3	0	0			
Total Contact Hours		: 45Hrs		**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	: 70
Credit		: 3		Progressive Assessment	: 30

RATIONALE:

In Recent days robots are used in automation industries. Knowledge & Familiarization of robots will be considered as an added advantage in the field of Automation.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Understand the basic knowledge on robotics.
- Demonstrate the different types of robot programing & distinguish between them
- Design various types of linkage mechanism for obtaining specific motion and analyze them for optimal functioning.
- Inspect the knowledge related to control techniques related to robot systems.
- Explore the knowledge of different types of sensors used in robot systems.

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours
Unit 1	Introduction To Robotics: Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots- Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots and Swarm robots. Safety measures in robotics, social impact, Robotics market and the prospects, advantages and disadvantages of robots.	9

Unit 2	Robot Anatomy and Motion Analysis: Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope.	7
Unit 3	Robot Drives and End Effectors: Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.	11
Unit 4	Control Components and Sensors: Mechanical control by stops and cams, Solenoids, Relays; Internal Sensors, potentiometers, resolvers and encoders; External sensing: Simple touch sensing, strain sensing, tactile sensing, acoustic sensing, magnetic sensing, capacitive sensing, laser sensing. Machine vision: Introduction to machine vision, the sensing and digitizing function in Machine vision. Image processing and analysis, training and vision system.	9
Unit 5	Path Planning: Definition-Joint space technique, Joint space planning, Cartesian space planning, Cartesian trajectories, Point to point vs continuous path planning. Methods of Robot Programming: Online and offline programming, Lead-through and Walk-through programmmg. Robotics Applications: Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing.	9

REFERENCES:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012). R.K. Mittal & I.J. Nagrath, “Robotics & Control” TMH-2007.
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.
4. Saeed B. Niku, “Introduction to Robotics – Analysis, Systems and Application” : PHI 2006.
5. Richard D, Klafter, Thomason A ChmielOwski, Michel Nagin “Robotics Engg-an Integrated Approach” PHI 2005.
6. Saha, S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014

TH:2- INDUSTRIAL AUTOMATION				
L	T	P	Total Marks: 100	Code: MEPC303
3	0	0		

Total Contact Hours	: 45Hrs		Theory Assessment	
Theory	: 45Hrs		End Term Exam	: 70
Credit	: 3		Progressive Assessment	: 30

RATIONALE:

Understanding of various components of state-of-art automation technologies are essential to encountered in modern manufacturing industries. So Industrial Automation is a set of technologies and techniques used to improve efficiency, stability, and responsiveness of industrial processes. It is very important for the students to learn the basics of automation, how the system works and the importance of PLC, DCS and SCADA in industrial automation and control. This course attempts to provide basic knowledge of these technologies to develop operational competency. Therefore, this course is the foundation for engineers who want to further specialize in the Industrial automation field.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Demonstrated the knowledge of various devices used for industrial automation and their application, which will help students in their projects and knowledge in industry.
- Explain the basic open loop and closed loop control system
- Apply basic control schemes and various complex controllers
- Explore the programming and implementation of programmable logic controllers.
- Prepare a simple DCS and SCADA application.

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours
Unit 1	Factory Automation and Integration: Basic concepts, types of automation, automation strategies, automation technologies, applications around us and in manufacturing industries. Processes; Classification of Control system; Open loop and Close loop system; elements used in feedback control system; control loop study, samples of disturbances, control actions.	05
Unit 2	Basic Control Schemes and Controllers: On – off Control; Time proportional control; PI Control; PD Control; PID Control. Controller: Block diagram; Types of controllers; Self operated controllers; Electronic controller; Analog controller; Pneumatic controller; comparison between Pneumatic & Electronic controller; Hydraulic Controller;	07
Unit 3	Tuning of Controllers: Concept of tuning – Criteria for controller tuning – Quarter decay ratio, IAE, ISE, ITAE – Methods of tuning – Open loop response method – Process reaction curve –Closed loop response method – Ultimate cycle method, Damped oscillation method.	05
Unit 4	Complex Control: Ratio Control: Objectives; Applications; Furnace Air / fuel ratio control system Cascade Control: Design of Cascade Control System in shell and tube heat exchanger and Continuous Stirred Tank Reactor (CSTR); Feed forward Control: Analysis of combine Feedback and feed forward control in a boiler drum level, CSTR, Shell tube heat exchanger etc., Mathematical Details of the algorithm. Inverse Derivative Control: Objectives and advantages; Controller Tuning; Selective Control; Process example. Override control: Objectives; Loop diagram description; Design and Analysis.	12

	Split range control: concept; design and analysis of split range control system Characteristic equation; few process examples.	
Unit 5	Distributed Control System: Overview of DCS; DCS software configuration; DCS communication; DCS supervisory computer tasks; DCS integration with PLC and computers; Features of DCS; Advantages of DCS	08
Unit 6	Artificial Intelligence in Industrial Automation: AI evolution, Industry 4.0, Smart Manufacturing, AI & Machine Learning Basics: Supervised/unsupervised learning, classification, regression, Deep Learning in Industrial Settings: Neural networks, CNNs, LSTMs, Predictive Maintenance: Failure prediction, anomaly detection, sensor analytics.	08

REFERENCE:

1. Stephananopoulos G - Chemical Process control- An Introduction to theory and practice, PHI, 1990.
2. Luyben W L – Simulation and control for chemical engineers, 1989, 2nd Edition, Mc Graw Hill. Harriot - Process control, TMH, New Delhi.
3. Patranabis, D - Principals of Industrial Instrumentation, TMH New Delhi.
4. Johnson, C – Process Control Instrumentation Technology, PHI New Delhi.
5. Rangan, C.S., Sarma, G.R. and Mani V.S.V, - Instrumentation: Devices and Systems, TMH.
6. Groover, M. P., Automation, Production System & Computer Integrated Manufacturing, Pearson Education Asia (2009).
7. Nakra, B. C., Theory and Applications of Automatic Controls, Revised 2nd Edition, New Age International Publishers (2014).
8. Morriss, S. B., Automated Manufacturing Systems, McGraw Hill (2006).
9. Programmable Logic Controllers by Frank Petruzella.
10. Donald P Eckman, Process control, Wiely Eastern limited,1991
11. Michael P Lukas - Distributed control system (Their evaluation and design), Van Nostrand
12. Reinhold Company Inc, 1986.
13. Douglas M. Considine, Process /Industrial Instruments Handbook, fourth edition, McGraw Hill,Inc.

TH:3- PLC, HMI AND SCADA					
L	T	P	Total Marks: 100	Code: MEPC305	
3	0	0			
Total Contact Hours		: 45Hrs		**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	: 70
Credit		: 3		Progressive Assessment	: 30

RATIONALE:

The PLC is widely used in industry for critical automation work as well as having an exposure about PCS as well as SCADA. Sound Knowledge about Familiarization of PLC, developing ladder diagrams, usage of timer & counter is necessary in the field of automation.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Understand Basic concepts of PLC.
- Draw and explain the ladder diagram to enhance the skill set of the participants on Hardware & Programming basics and servicing.
- Applications for PLC
- Trained in automation products like PLC, HMI and SCADA to control and monitor the plant and machine.

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours
Unit 1	Basic Concepts of PLC: Introduction to Programmable Logic controller – Hardwired circuits versus PLC control – Advantages of PLC control – Relays – Different relay logic circuits using push buttons(NO/NC), relays and dc loads. Block diagrams of PLC. Parts of PLC – Processor – Memory – Input and output modules – Digital and Analog I/O's – PLC scan cycle- Input, output and	7

	memory addressing-PLC wiring(sinking/sourcing) Boolean algebra and combinational Logic circuits.	
Unit 2	Programming and Applications of PLC: Programmable Logic Controllers (PLC) based control system, programming languages. Ladder diagram for Logic functions (OR, AND, NAND, EX-OR & EX –NOR),Ladder Programming using Bit logic instruction – timer- counter –MOVE operation-Arithmetic Operation-Comparators – data handling instruction – simple ladder diagrams for star- delta starter – Ladder diagrams for DOL starter – Cylinder sequence Application – Cylinder sequence using counter – Ladder diagram using Latch circuit – Ladder diagram using Timer – Ladder diagram using counter – sequence of the operation and ladder diagram for multi cylinder application – sequence of the operation and ladder diagram for 4-way traffic light control - Creating ladder diagrams for process control-LAD, STL& FBD. Analog PLC operations (Normalization and scaling) and Final Control Elements: Signal converters – P to I Converter, I to P Converter – Actuators – Electrical, Pneumatic, Hydraulic and Electro pneumatic – Valve Positioners, Software and hardware troubleshooting in PLC circuit.	22
Unit 3	Industrial networks and communication protocols: Introduction to industrial networks, Overview of communication protocols: MODBUS, PROFIBUS, Ethernet /IP and CAN bus. Network topology and communication media. Network design for automation systems: Designing robust and scalable industrial networks, Ensuring network security and reliability. PLC to PLC communication, OPC UA, RFID Technology and Machine Vision.	06
Unit 4	HMI & SCADA: Human Machine Interface (HMI): HMI & graphic design tools, Integrating HMI with PLC systems. Introduction to SCADA, typical SCADA architecture in block diagram, benefits of SCDA; Various editors of SCADA; Interfacing SCADA system with PLC: typical connection diagram. Object linking and embedding for process control architecture, steps in creating SCADA screen for simple object, steps for linking SCADA object with PLC ladder program using Process Control.; Applications of SCADA: Traffic light	10

	control, water distribution, pipeline control.	

REFERENCE:

1. Garry Dunning, Introduction to Programmable Logic Controller.
2. Frank Petruzella, Programmable Logic Controllers, TMH.
3. John W.Webb, Ronaid A. Reis, Programmable Logic Controllers
4. Dr Mitra & Dr S. Sengupta, Programmable Logic Controllers
5. Manuals of (a) Siemens, (b)Fanuc, (c)Allen Bradl

PR:1- ROBOTICS LAB					
L	T	P	Total Marks: 50	Code: MEPC307	
0	0	4			
Total Contact Hours		: 60Hrs		**Practical Assessment**	
Practical		: 60Hrs		End Exam	: 15
Credit		: 2		Progressive Assessment	: 35

RATIONALE:

Robotics labs provide an ideal environment for students to apply science, technology, engineering, and mathematics (STEM) concepts in a practical and meaningful way. Through building and programming robots, students can directly observe how these concepts come to real life situation. This will be helpful to the students about the robots for automation work in the field of material handling, machine operation work etc.

LEARNING OUTCOMES:

After completion of the Lab the students will be able to

- Identify different parts of robots and components and Assess kinematics & dynamic analysis of robot manipulators.
- Understand the functionality and limitations of robot actuators.
- Program a robot to perform a specified task in a target environment and solve problems in areas such as robot control and navigation.
- Explain how simulations of robots, where they can be useful and where they can break down.
- Study and use vision system in robot application

DETAILED COURSE CONTENTS

Sl No	List of Experiments
1	Study the safety instructions and Do's & Don't guidelines.
2	Study the major equipment's/Software/Components in Robotics Lab, e.g. Robotic Arm components, Arena etc.
3	Integration of Actuators with the Robot Controller's I/O Module.

4	Integration of Sensors with the Robot Controller's I/O Module.
5	Verification of Functional Keys of Teach Pendant along with modes of operation.
6	Manipulate a 6-axis robot through Teach Pendant and Verify the Robot's motion by changing Coordinates.
7	Perform Create, Modify & Delete operation to an instruction in a program.
8	Perform teaching of different geometrical shapes using appropriate interpolation type.
9	Perform Tool Calibration & teaching operation using tool coordinate.
10	Perform teaching and jogging of a 6-axis robot through a dedicated path using motion (MOV)instructions.
11	Perform teaching and jogging of a 6-axis robot through a dedicated path using motion (MOV) and Input/Output instructions.
12	Perform Pick & Place operation through programming
13	Perform Pick & Place operation through programming using different work plane.
Exercise on any Robotic Simulation Software	
14	Determination of maximum and minimum position of links.
15	Estimation of accuracy, repeatability and resolution.

REFERENCE:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Richard D, Klafter, Thomason A Chmiel Owski, Michel Nagin "Robotics Engg-an Integrated Approach" PHI 2005.
3. R.K. Mittal & I.J. Nagrath, "Robotics & Control" TMH-2007.

PR:2- INDUSTRIAL AUTOMATION & PLC LAB					
L	T	P	Total Marks: 50	Code: MEPC309	
0	0	4			
Total Contact Hours		: 60Hrs		**Practical Assessment**	
Practical		: 60Hrs		End Exam	: 15
Credit		: 2		Progressive Assessment	: 35

RATIONALE:

Several integrated control system design and development and implementation with accompanying hardware will be used throughout this Laboratory course. The purpose of these studies is to help develop in each student a balance among modelling, analysis, and control techniques; computer simulation and interpretation of results; key issues of hardware implementation; and comparison of simulations and experiments. The defining quality of a control engineer is the ability to work competently in these four areas.

LEARNING OUTCOMES:

After completion of the Lab the students will be able to

- Design various control systems
- Implement physically the control systems through hardware
- Simulate the control systems through software
- Analyze the performance of different types of control system

DETAILED COURSE CONTENTS

Sl No	List of Experiments
AUTOMATION	
1.	Closed-Loop temperature Control System
2.	Closed-Loop liquid level Control System
3.	Closed-Loop pressure Control System
4.	Stepper Motor Open-Loop and Closed-Loop Motion Control System.
5.	Closed-Loop Brushless DC Motor Position and Velocity Control System
6.	Logic implementation for DoL and star-delta starter
7.	Interfacing PLC with SCADA and PLC parameter reading in SCADA
8.	Temperature sensing using SCADA

PLC	
9.	Study hardware and software used in PLC.

10.	Implementation of logic gates in PLC.
11.	Implementation of bit logic instructions. arithmetic instruction.
12.	Study, understand and perform experiments on and off delay timers.
13.	Implementation of MOVE and comparators instruction.
14.	Logic implementation for two way and four way traffic control application.
15.	Study, understand and perform experiments on UP, DOWN and UP/DOWN counters.
16.	Logic implementation of automatic car parking system (entry and exit count)
17.	Implementation of arithmetic instruction.
18.	Logic implementation of arithmetic calculator (ADD, SUB, MUL, DIV, MOD)
19.	Logic implementation for bottle filling application.
20.	Study and simulate analog function blocks.
21.	Logic implementation for analog parameter reading.
22.	Logic implementation to count and display values on Seven segment display
23.	Direct control of double acting cylinder.
24.	Cascading operation of multiple double acting cylinders.
25.	Study hardware and software used for HMI programming.
26.	Start and stop control of any process using HMI.

PR:3- AUTO CAD LAB					
L	T	P		Code: MEPC311	
0	0	4			
Total Contact Hours		: 60Hrs		**Practical Assessment**	
Practical		: 60Hrs	Total Marks: 50	End Exam	: 15
Credit		: 2		Progressive Assessment	: 35

RATIONALE:

This technology now-a-days is extremely used by many manufacturers, both large and small used multiple 2D and 3D authorizing systems sometimes using single design projects or functions. By using CADD software, we can produce the job piece any geometry with high accuracy and safety.

LEARNING OUTCOMES:

After completion of the Lab the students will be able to

- Focuses on how to use AutoCAD (Automatic Computer-Aided Design), a powerful software application used for drafting and designing in various industries such as architecture, engineering, construction, manufacturing etc.
- Preparation of Architectural drawings in the Auto CAD
- Describe of maps of an area
- Preparation of Building/circuit drawings
- Apply of circuit layouts for water distribution and sewer systems

DETAILED COURSE CONTENTS

Sl No	List of Experiments
1	INTRODUCTION TO COMPUTERS AND ITS APPLICATIONS

	1.1	Definition of Computer – Computer Applications – Classification Parts of Computer – Functions– I/O Devices – Computer Peripherals Hardware & Software – Categories of Software –Operating System Functions of Operating Systems – Computer Languages.
	1.2	DOS – Internal Commands & External Commands Practice Exercise

	1.3	Introduction to Windows Operating System Practice Exercise
	1.4	Exploring MS Office (MS Word, MS Excel, MS Power Point)
	1.5	One simple project in MS Word, MS Excel, MS Power Point.
2	**INTRODUCTION TO AUTO CAD**	
	2.1	Importance of Auto CAD menu selection, begin new drawing, editing10 existing drawing and practice simple drawing.
	2.2	Co-ordinate system in CAD-absolute, relative and polar
	2.3	Introduction to utility commands – Help, End, Quit, Save, Limits, Units Practice.
	2.4	Introduction to entity draw commands –Line, Point Circles, Oops, Undo Copy, Move practice
	2.5	Introduction to display commands – Zoom, Pan, Redraw practice
	2.6	Layers and its uses
	2.7	Various file formats – export and import of files
3	**ORTHOGRAPHIC PROJECTIONS CONTINUED 28**	
	3.1	Exercises on drawing the 3 views of different types of objects in 1stangle Projection.
4	**ADVANCED CAD & ENGINEERING DRAWING**	
	3.2	Function of components in assemblies, solid modeling, assembly, Drafting, 3-D wire frame geometry and surfacing using PRO-ENGINEERING Willfire-3 Software.

REFERENCES

1. Auto CAD 2000 - George Omura
2. CAD/CAM – Principle & Applications – Rao
3. Machine Drawing by N D Bhatt
4. Machine Drawing by T Jones
5. Machine Drawing by R K Dhawan

TH:4(A)- MICRO MECHATRONIC SYSTEMS					
L	T	P	Total Marks: 100	Code: MEPE301A	
3	0	0			
Total Contact Hours		: 45Hrs		**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	: 70
Credit		: 3		Progressive Assessment	: 30

RATIONALE:

The micro mechatronics field involves designing and manufacturing mechatronic devices with dimensions ranging from 1 micrometer to 1 mm. As the micro world scales, micro mechatronics integrate both mechanical and electronic systems. Consumer products that include electronics typically contain a micro mechatronics system as part of the mechanical system.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- State different types of micro-mechatronics elements
- Explain the operation of micro-mechatronics sensors
- Explain the operation of micro-mechatronics actuators
- Describe various case studies on micro-mechatronic systems

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours
Unit 1	**Micro-Mechatronics:** Introduction, Micro-Mechatronics elements, Microprocessor, Micro-sensor, Micro actuator, Interface, Energy, Materials, Machining, Micro physics, Applications of Micro Mechatronics. Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc.	11
Unit 2	**Micro – Sensors:** Introduction, Micro-sensor measurement principle, Micro-sensor fabrication techniques, modeling, Micro pressure sensors, Micro accelerometer, sensors, Micro thermal sensors, Micro floor sensors, Micro chemical sensors, Micro optical sensors, Micro sensor for humidity and displacement,	12

	application of micro sensors.	

Unit 3	**Micro actuators**: Introduction, classification of micro actuators, electromagnetic, electrostatic, piezo electric, optical micro – actuators.	09
Unit 4	**Case study of Micro Mechatronics systems:** Testing of transportation Bridge surface materials, Transducer Calibration system, Strain Gauge Weighting system, Solenoid force, Displacement Calibration System, Rotary Optical Encoder, Thermal Cycle Fatigue of a Ceramic Plate, pH control, Temperature control system, Skip control of a CD Player, Robot Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	13

REFERENCE:

1. Micro Mechatronics, By Kenji Uchino.
2. Strategic Innovation For Micro Mechatronics, By Dr. Bharatbhushan Joshi and Nachiket Prakashgan
3. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).
4. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education.
5. A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited.
6. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hal

<table>
<tr><th colspan="6">TH:4(B)- DIGITAL SIGNAL PROCESSING</th></tr>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="4">Total Marks: 100</td><td colspan="2">Code: MEPE301B</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Contact Hours</td><td>: 45Hrs</td><td colspan="2">Theory</td></tr>
<tr><td colspan="2">Theory</td><td>: 45Hrs</td><td>End Term Exam</td><td>: 70</td></tr>
<tr><td colspan="2">Credit</td><td>: 3</td><td>Progressive Assessment</td><td>: 30</td></tr>
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RATIONALE:

The purpose of this course is to provide an understanding of Digital Signal Processing which includes digital signal processing and application, discrete time signals and systems; Analysis of LTI systems; Structures of discrete time systems; Filter designing techniques; DFT and FFT; Architecture of DSP Processors, and Multi-rate Signal Processing and applications. Digital signal processing (DSP) helps the students to analyze, process, and design digital signals. DSP is versatile technology that is used in many fields, including communications, audio and speech processing, and medical signal analysis.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Understand the elements of embedded system and State different types of signals and systems
- Explain Linear Shift Invariant system and realization structure & Discrete and Fast Fourier Transforms
- State Different types of Finite impulse Response (FIR) Filters and Infinite impulse response (IIR) Filters
- Solving problems with Digital Signal Processing
- Interface different components of embedded system and its programming.

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours
Unit 1	**Introduction:** Introduction to signals and systems and representation of signals in time domain, Linear time invariant systems, impulse response and convolution sum, z transform and its properties, Inverse z-transform, Difference equation.	06
Unit 2	**Linear Shift Invariant system and realization structure:** Review of the Theory of LSI System, Discrete Time Fourier Transform (DTFT), Frequency Response of LSI system, Frequency response of First Order systems; Frequency Response of Second Order Systems, Realization Structures.	07
Unit 3	**Discrete And Fast Fourier Transforms:** Discrete Convolutions – Circular and Linear, Sectioned Convolutions, Discrete Fourier Transform and its Properties, Relation between Z-Transform and DFT, Introduction to Radix 2 FFT (Fast Fourier Transform), Properties of Radix 2 DIT algorithms, Decimation in Frequency Radix- 2 FFT, Computation of Inverse DFT Through FFT	10
Unit 4	**Finite impulse Response (FIR) Filters:** Magnitude and Phase Response of FIR Filters, Linear Phase Response of FIR Filters, Linear Phase Response of Filters, Design of FIR Filters – Windowing (Fourier Series) Method, Design of FIR Filters Frequency Sampling Method.	10
Unit 5	**Infinite impulse response (IIR) Filters:** General Considerations, Design of Butterworth Filters, Design of Chebyshew Filters, Conversion of Analog of Digital Filters, Bilinear Transform Method.	06
Unit 6	**Programming & Application:** Popular architecture and overview of programming Application of DSP, Speech and Audio Signal Processing, Radar Signal Processing.	06

REFERENCES:

1. Digital Signal Processing by Proakis and Manolokis
2. Digital Signal Processing by S K Mitra
3. Theory and Application of Digital Signal Processing by Rabinar L R and Gold B
4. Introduction to Digital Signal Processing by Johnson
5. Digital Signal Processing by Alan V Oppennheim
7. Digital Signal Processing by A Nagoor Kani
8. Digital Signal Processing by A Anand Kumar
9. Digital Signal Processing by Salivahanan
10. Digital Signal Processing by Ronald W Schafer

TH:4(C)- EMBEDDED SYSTEM					
L	T	P	Total Marks: 100	Code: MEPE301C	
3	0	0			
Total Contact Hours		: 45Hrs		**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	: 70
Credit		: 3		Progressive Assessment	: 30

RATIONALE:

Embedded control systems can be defined as a combination of hardware and software that are embedded into a larger system to control, manage, and monitor processes autonomously. They operate within predefined parameters and interact with specific peripherals to perform a specific function. An embedded systems course is designed to expose learners to the core concepts of the field while providing an array of embedded systems examples.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Explain interaction between the control design and control implementation
- Describe the advanced concepts of Embedded System Architecture
- Design software systems such as RTOS using embedded controllers.
- Develop modelling of systems for various embedded applications.
- Do the activities involving embedded control.
- Use embedded C programming language to maintain embedded systems

DETAILED COURSE CONTENTS

Unit	Topic/Subtopic	Hours

Unit 1	**Introduction to Embedded System:** Block diagram of embedded system with hardware components; Hardware and Von-Neumann architecture; RISC and CISC processors; Characteristics of Embedded System – Processor – Power – Memory - Operating system – Reliability – Performance - Power consumption - NRE cost - Unit cost, size, flexibility - Time to prototype and time to market – Maintainability - Correctness and safety. Classification of Embedded System - Small scale - Medium scale – Sophisticated – Standalone - Real time.	13
Unit 2	**Embedded System Design:** The concept of embedded systems design; Embedded microcontroller cores; Embedded memories.	06
Unit 3	**Examples of embedded systems:** Technological aspects of embedded systems - Interfacing between analog and digital blocks - Signal conditioning - Digital signal processing - Sub-system interfacing - Interfacing with external systems - User interfacing. Design tradeoffs due to process compatibility and thermal considerations	10
Unit 4	**Software aspects of embedded systems:** Real time programming languages; Operating systems for embedded systems.	6
Unit 5	**Programming Embedded System in C:** Data transfer; Arithmetic and Logical operations; Decision Control & Looping; Timer/Counter Programming with Embedded C for Microcontroller; Interrupt Control programming with Embedded C for Microcontroller.	10

REFERENCES:

1. Alexandru Forrai, ¯Embedded Control System Design A Model Based Approach‖, Mitsubishi Elevator Europe Veenendaal The Netherlands—Springer.
2. Adamski, Marian Andrzej, Karatkevich, Andrei, Wegrzyn, Marek¯Design of Embedded Control Systems, Springer
3. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
4. .Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.
5. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995
6. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
7. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", PenramIntl, 1996.

TH:5(A)- UNIVERSAL HUMAN VALUES

L	T	P		Course Code: OE 301A	
3	0	0			
Total Contact Hours					
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre-Requisite		**: Nil**			
Credit		**3**		Category of Course: OE	

RATIONALE:

The Universal Human Values (UHV) course aims to help diploma students develop a strong ethical foundation, nurturing responsible individuals who contribute positively to society. In an era driven by rapid technological advancements, it is crucial for students not only to gain technical expertise but also to cultivate values that promote harmony, respect, and sustainability.

LEARNING OUTCOMES:

After completion of the course, the students will be able to:

- Identify fundamental human aspirations such as happiness and prosperity.
- Differentiate between the self and the body and understand their respective needs.
- Practice self-reflection to improve decision-making, emotional balance, and personal growth.
- Develop respectful and trustworthy relationships within family, friends, and society.
- Explain the role of values like trust, respect, and love in building strong social bonds.
- Promote cooperation and harmony within communities through ethical practices.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Introduction to Value Education and Human Values -** Concept and Need for Value Education - Understanding the importance of value education in personal and professional life, Differentiating between values and skills. Basic Human Aspirations - Exploring fundamental human aspirations: happiness and prosperity, Methods to achieve these aspirations through right understanding and relationships.	8
II	**Harmony in the Human Being -** Understanding the Self - Differentiating between the 'Self' (I) and the Body, Understanding the needs of the Self and the Body, Harmony of the Self with the Body - Ensuring the harmony of 'I' with the Body, Practices for mental and physical well-being.	8

III	**Harmony in the Family and Society -** Family as the Basic Unit of Society - Understanding values in human relationships, Trust and respect as the foundational values in relationships, Harmony in Society - The concept of an undivided society, Universal human order and world family.	8
IV	**Harmony in Nature and Existence -** Interconnectedness in Nature - Understanding the four orders of nature: material, plant, animal, and human, Mutual fulfillment among these orders, Co-existence in Existence - Holistic perception of harmony in existence, Role of human beings in maintaining environmental balance.	8
V	**Professional Ethics -** Ethical Human Conduct - Integrating values into professional life, Concept of professional ethics and accountability, Case Studies in Professional Ethics - Analyzing real-life scenarios to understand ethical dilemmas, Developing solutions based on universal human values.	8
VI	**Personal Development and Social Responsibility -** Self-Reflection and Self- Exploration - Techniques for self-assessment and personal growth, Setting personal goals aligned with universal values, Social Responsibility - Understanding one's role in society, Participating in community service and social initiatives.	5

REFERENCES:

1.	R. R. Gaur, R. Asthana, G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019.
2.	R. R. Gaur, R. Asthana, G. P. Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019.
3.	A. Nagraj, JeevanVidya: EkParichaya, Amarkantak, 1999.
4.	A. N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
5.	Moral Thinking: An Introduction To Values And Ethics, Vineet Sahu, IIT Kanpur: https://onlinecourses.nptel.ac.in/noc23_hs89/preview

TH:5(B)- LEADERSHIP AND MANAGEMENT SKILLS

L	T	P		Course Code: OE301B	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre-Requisite		**: Nil**			
Credit		**3**		Category of Course: OE	

RATIONALE:

This course/subject on Leadership and Management Skills for students undergoing Diploma programmes is an exploration in leading and managing people, majorly in education based on sound and acceptable principles and theories for effective leadership. The leadership skills will enable them to take initiative, guide team efforts, motivate peers, and ensure effective collaboration. They'll learn how to delegate tasks, resolve conflicts, and foster a positive team environment. The management skills will help them in organizing tasks, setting timelines, and ensuring efficient workflow within a team.
It is expected that the students will be able to handle projects with better project outcomes and a earn a more productive learning experience. This will benefit their academic journey, future careers, and overall professional development:

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the principles of management
- Collaborate across cultures for effective team work
- Communicate with people for a positive work culture
- Demonstrate personal dispositions, skills & abilities of a leader
- Undertake the process of change management
- Design training for staff development
- Adapt suitable leadership style for improved work efficiency.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Leadership & Management, concept, principles.** • Definition of leadership, management • Leadership theories • Leadership characteristics • Principles of management • Managerial functions	**10**

	• Leader v/s Manager, Leader/Manager traits and character • Leadership Styles	
II	**Human Resource Management in Organizations** • Human Resource Management: Meaning, Nature, Objectives, Scope • Job & Job analysis. • Staff Development: Need and Objectives of Staff Development, Approaches • Training & development • Organizational Development: Components of OD process. • Learning organization	10
III	**Personal disposition, skills & abilities of leaders** • Self-awareness • Leadership characteristics, traits • Leadership skills & abilities • Emotional intelligence & its components, importance in leadership • Communication skills for effective leadership, barriers to effective communication, Active Listening, Mindful listening. • Leading & Mentorship – Influencing & mentoring	09
IV	**Leader's role in Motivating, Inspiring and Transformative leadership, nurturing team-work** • Goal setting & leadership • Transformative Leadership, vision & envisioning • Motivational role of leader in people management • Group & team • Team dynamics • Conflict management, strategies in managing conflicts	08
V	**Change Management & Leadership** • Models of change • Forces driving change • Change Management – process, goal, importance • The process of change happening in an organization • Key aspects of leadership in change management – responsibilities of a change leader.	08

SUGGESTED ACTIVITIES:

- Group/individual presentation on the basic principles of leadership and management, Discussion on readings - Individual or group presentation of assigned topics in class on leadership and management principles and theories.
- Activities on Envisioning, Goal setting
- ACTION PLAN to be prepare

REFERENCES:

1.	Theories of Educational Leadership and Management (3rd ed.), by Bush, Tony (2003). SAGE Publications, Ltd.
2.	The inspiring leader: unlocking the secrets of how extraordinary leaders motivate. By Zenger, John, Joseph Folkman, and Scott Edinger (2009). New York: McGraw Hill Press.
3.	Knowing yourself. On becoming a leader: the leadership classic. By Bennis, Warren (2009). New York: Basic Books.
4.	Leading Change. By P. Kotter, Harvard Business, 2012.
5.	The Fifth Discipline. By Peter M. Senge, Crwon Currency, 2006.
6.	The Leadership Sutra: An Indian Approach to Power. By Devdutt Pattanaik, – Penguin Random House, 2017.
7.	Leadership and Management. By Dr. A. Chandra Mohan. Himalaya Publishing House, 2010.

TH:5(C)- PROFESSIONAL SKILLS

L	T	P		
3	0	0		**Course Code: OE301C**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs		End Term Exam 70
			Total Marks: 100	Progressive Assessment 30
Pre-Requisite		**: Nil**		
Credit		**3**		Category of Course: OE

RATIONALE:

The term, "Professional skills" carries significant weight in the job market and career development. This open elective course explores various types of professional skills, their significance, and how they can be cultivated and harnessed for career progression. By understanding the landscape of professional skills, student can better position himself or herself for success in the competitive job market. It is crucial to continuously update and adapt the professional skills to stay ahead in a rapidly changing work environment. By investing in professional development, one can enhance employability and open doors to new opportunities.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Demonstrate Self-competency and Confidence
- Practice Emotional Competency
- Work in a team work or in collaboration
- Demonstrate problem solving and decision making skills
- Apply time management strategies and techniques effectively
- Apply professional ethics and integrity in professional and personal life

UNIT NO.	CONTENT	ALLOTTED TIME (HOURS)
I Communication Skills:	• Active listening • Verbal and non-verbal communication • Written communication • Presentation skills • Conflict resolution	08
II Teamwork and Collaboration:	• Building trust within a team • Effective collaboration strategies • Role delegation and responsibility sharing • Conflict resolution within a team	08
III Problem-Solving:	• Identifying root causes of issues • Generating solutions and evaluating options	08

	• Decision-making under pressure • Critical thinking skills • Triple constraint issues	
IV Time Management:	• Prioritization and task management • Setting realistic deadlines • Effective time planning and organization	06
V Emotional Intelligence:	• Self-awareness and emotional regulation • Empathy and understanding others' emotions • Managing interpersonal relationships • Motivation • Social skills • Emotional Intelligence (EQ) • Stress management	08
VI Professional Ethics and Integrity:	• Workplace ethics and code of conduct • Confidentiality and data privacy • Professional accountability- • Important Considerations:	07

REFERENCES:

1. Dr. Vitthal Gore: Professional Skills for 21st Century: A Key to Success: Blue Rose- ACADEMIC
2. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success: PEARSON
3. The essence of Leadership: S. Manikutty: Bloomsbury

<table>
<tr><th colspan="6">SUMMER INTERNSHIP - II</th></tr>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="3">Total Marks: 50</td><td colspan="2">Code: SI301</td></tr>
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<tr><td colspan="2">Total Contact Hours</td><td>:3 - 4 weeks</td><td colspan="2">Internship Assessment</td></tr>
<tr><td colspan="2">Internship</td><td>:3 - 4 weeks</td><td>End Exam</td><td>: 15</td></tr>
<tr><td colspan="2">Credit</td><td>: 2</td><td>Progressive Assessment</td><td>: 35</td></tr>
</table>

3 to 4 weeks Internship after 4th Semester

RATIONALE:

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. It offers the employer the opportunity to bring new ideas and energy into the workplace, develop talent and potentially build a pipeline for future full-time employees.

LEARNING OUTCOMES:

- Opportunity for "hands-on" experience
- Opportunity to sample various career options
- Preparation for job searches
- Provides a clear job/project description for the work experience.
- Orients the student to the organization, its culture and proposed work assignment(s).
- Helps the student develop and achieve learning goals.
- Offers regular feedback to the student intern.

DETAILED COURSE CONTENTS

Internship of 4-6 Weeks shall be performed during summer break after semester IV and will be assessed as part of Semester III. During the summer vacations, after the 2nd Semester, students are required to be involved in Inter/ Intra Institution Activities viz.; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institution; contribution at incubation/ innovation /entrepreneurship cell of the Institution;

participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovations Council for e.g.: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

After completion of Mini-project or Internship the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period or while working on mini-project. The student may contact the Industrial Supervisor/ Faculty Mentor/TPO to assign special topics and problems and should prepare the final report on the assigned topics. Student's Diary and Internship Report should be submitted by the students along with attendance record and an evolution sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawing, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information

<table>
<tr><th colspan="6">PR:4- MAJOR PROJECT</th></tr>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="4">Total Marks: 50</td><td colspan="2">Code: PR301</td></tr>
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<tr><td colspan="2">Practical</td><td>: 60Hrs</td><td>Practical Exam</td><td>: 15</td></tr>
<tr><td colspan="2">Credit</td><td>: 2</td><td>Progressive Assessment</td><td>: 35</td></tr>
</table>

RATIONALE:

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of MECHATRONICS and practices in real life situations, so as to participate and manage a large organization and projects, in future.

Entire Project shall spread over 5th and 6th Semester. Part of the Project covered in 5th Semester shall be named as Project Decertation-I and the balance portion to be covered in 6th Semester shall be named as Project Decertation-II.

LEARNING OUTCOMES:

After completion of the course the students will be able to

- Expose to self-learning various topics.
- Survey the literature such as books, national/international referred journals and contact resource persons for the selected topic of research.
- Learn to write technical reports.
- Develop oral and written communication skills to present and defend their work in front of a technically qualified audience.
- Develop professional values and ethical standards.
- Handle real life challenges by making effective decisions to complete project work.
- Show skills in developing real world applications

STUDENT'S ACTIVITY

Students will do their project work as guidance from their guide (faculty member).

Guidelines:

The individual students have different aptitudes and strengths and also areas of interest. Project work, therefore, should match the strengths and interest of the students. For this purpose, students should be asked to identify the type of project work they would like to execute. The activity of problem identification should begin well in advance (right from beginning of 5th semester). Students should be allotted a problem of interest to him/her as a project work. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be an individual assignment or a group assignment. Preferably there should not be more than 5 students if the project work is given to a group. The project work identified in collaboration with industry/organization should be preferred.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	Performance Criteria
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
It is proposed that the institute should organize an annual exhibition of the project work done by the students and invite leading Industrial organizations of area of subject to such an exhibition.

Project Phase-I and Phase-II

The Project work duration shall cover 2 semesters (5th and 6th sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group shall be done in the beginning of 5th semester under Project Phase-I. The students may be allowed to study literature, any existing system and then define the Problem/objective of the Project. Requirements specification and Preliminary work of the system have

to be completed in Phase-I. Project Milestones are to be set so that progress can be tracked. In Phase-II Detailed work, Documentation has to be complete. *Project Report have to be prepared and complete in Phase-II.* All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alterations in the components of Task and schedule.

At the end of Project Phase-I in the 5th semester there shall be one presentation by each group to mark to progress and also to judge whether the Project is moving in right direction as per the objective of the Project.