	Course Title: **MECHATRONICS**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME54T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE- 100 Marks

Prerequisites: Knowledge of Basic Science, Mathematics, Basic Electrical and Electronics Engineering and Mechanical Engineering discipline courses

Course Objectives.

To expose the students in the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

Course out comes

On successful completion of the course, the students will be able to attain CO:

	Course Outcome	**CL**	**Linked PO**	**Teaching Hrs**
CO1	Discuss the importance of mechatronics systems and know the usage of Sensors and Transducers for automation applications	*R/U/A*	2	07
CO2	Acquire the knowledge of combinational and sequential logic circuits	*R/U/A*	2	11
CO3	Know the various electro and mechanical systems available for automation	*R/U/A*	2	06
CO4	Design the Building blocks of Mechanical, Electrical, Fluid and Thermal Systems	*R/U/A*	2	10
C05	Describe the significance of PLC for automation	*R/U/A*	2	11
C06	Know the importance of communication systems and its interface and Design the Mechatronics Systems.	*R/U/A*	2	07
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
MECHATRONICS	0	3	0	0	0	0	0	0	0	0

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

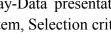| Unit No	Unit Name	Hour	Questions to be set for SEE			Marks weightage	weightage (%)
			R	U	A		
1	MECHATRONICS, SENSORS AND TRANSDUCERS	07	05	05	20	30	20.6
2	DIGITAL LOGIC AND DATA PRESENTATION	11	05	05	20	30	20.6
3	ACTUATION SYSTEMS	06	05	05	20	30	20.6
4	SYSTEM MODELS AND CONTROLLERS	10	05	05	20	30	20.6
5	PROGRAMMABLE LOGIC CONTROLLERS	11	-	05	10	15	10.8
6	COMMUNICATION AND DESIGN OF MECHATRONICS SYSTEM	07	-	-	10	10	6.8
	Total	52	20	25	100	145	100

Legend: R; Remember, U: Understand A: Application

UNIT I: MECHATRONICS, SENSORS AND TRANSDUCERS   07 Hrs

Introduction to Mechatronics Systems - Measurement Systems - Control Systems -Sensors and Transducers - Performance Terminology - Sensors for-Displacement, Velocity, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors, Selection of Sensors.

UNIT II: DIGITAL LOGIC AND DATA PRESENTATION   11Hrs

Digital signals-Introduction,-BCD system-Analog and digital signals- Digital to analog conversion.-Logic Gates-,AND-OR-NOT-NAND-NOR-XOR,Applications-Coder-Encoder-Decoder with seven segment display -LCD-(Traffic Light)-Sequential logic-,Flip Flops,-SR, JK, DFlip flops,-Registers- Data presentation system,-Display-Data presentation elements-Types-Printers- Dotmatrix, Laser printer, Data acquisition system, Selection criteria.

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UNT III: ACTUATION SYSTEMS   06Hrs

Electrical Actuation Systems - Mechanical Switches - Solid State Switches-Types –Diode-Power MOSFETs - Solenoids - D.C Motors-Basic working principle-Types- A.C Motors-Basic working principle-Types - Stepper Motors- Basic working principle - List Types - Stepper motor specifications
Mechanical Actuation Systems - Ratchet and Pawl - Bearings.

UNIT IV: SYSTEM MODELS AND CONTROLLERS   10Hrs

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems,-Rotational - Translational Systems,-Electromechanical Systems - Hydraulic - Mechanical Systems-Continuous and discrete process Controllers - Control Mode - Digital Controllers - Velocity Control - Adaptive Control.

UNIT V: PROGRAMMABLE LOGIC CONTROLLERS   11Hrs

Introduction to Memories – RAM, ROM, PROM, EPROM, EEPROM, Microprocessor-block diagram-Architecture of 8051, microcontroller- Architecture, pin configuration of Intel 8081, difference between microprocessor and microcontroller. Programmable Logic Controllers - Basic Structure - Input / Output Processing – Programming - ladder diagram - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogs Input / Output – Selection of PLC

UNIT VI: COMMUNICATION & DESIGN OF MECHATRONICS SYSTEM   07Hrs

Digital Communication Systems-Centralized, Hierarchical and Distributed Control-Networks-Protocols-Open Systems Interconnection communication model-Communication Interfaces-Possible Design Solutions Case Studies of Mechatronics Systems,-Car Park barrier Systems - Engine Management Systems- Hard disc drive.

TEXT BOOKS AND REFERENCES

Sl.No.	Title of Books	Author	Publication
1.	Mechatronics"	W.Bolton	Pearson education
2.	Mechatronics-Principles, Concepts and Applications	Nitaigour Premch and Mahalik	Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006
3	Mechatronics	HMT	Tata McGraw Hill Publishers, New Delhi
4.	Programmable logic controllers	W.Bolton	Pearson education
5	Digital electronics	Flyod	-
6	Exploring PLC with applications	Pradeep Kumar Srivatsava	-

LIST OF SOFTWARE/LEARNING WEBSITES

     1. http://www.vlab.com

2. http://www.mtabindia.com

3. http://www.nptel.ac.in

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	MECHATRONICS, SENSORS AND TRANSDUCERS	Lecturer, Demonstration, Video, Presentation
2	DIGITAL LOGIC AND DATA PRESENTATOIN	Lecturer, Demonstration, Video, Presentation
3	ACTUATION SYSTEMS	Discussions, real life industries situation, industrial visits. Expose to various actuation systems
4	SYSTEM MODELS AND CONTROLLERS	Teaching, Presentations, Industrial visits, movies.
5	PROGRAMMING LOGIC CONTROLLERS	Demonstration, Video, Presentation, Industrial Visit, Mini Project
6	COMMUNICATION AND DESIGN OF MECHATRONICS SYSTEM	Discussions, real life industries situation, industrial visits

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

1. Each student should do any one of the following type activity or any other similar activity related to the course and before conduction, get it approved from concerned Teacher and HOD.
2. *Each student should conduct different activity and no repeating should occur*

1	Each group of students Build and operate simple circuit using application of sensor and submit an hand written report
2	Conduct study on real time applications of different type of Sensors-each one from force & torque type, velocity and acceleration type, proximity type, position type and vision type. And submit a hand report on study
3	Each student will give an activity to Prepare simple circuit diagram for given conditions using logic gates.
4	Development of ladder diagram, programming using PLC for a) measurement of speed of a motor b) motor start and stop by using two different sensors c) simulation of a pedestrian traffic controller d) simulation of four road junction traffic controller e) lift / elevator control f) washing machine control g) tank level control h) soft drink vending machine control
6	Take case study on applications of mechatronics systems in nearby industry; submit report on same

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests (Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Report/Log of activity	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation   SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier: ***The following documents to be verified by CIE verifier at the end of semester***
1. Blue books(20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

• MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY

RUBRICS MODEL

<table>
<tr><th colspan="7">RUBRICS FOR ACTIVITY(5 Marks)</th></tr>
<tr><th rowspan="2">Dimension</th><th>Unsatisfactory</th><th>Developing</th><th>Satisfactory</th><th>Good</th><th>Exemplary</th><th rowspan="2">Student Score</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>**Collection of data**</td><td>Does not collect any information relating to the topic</td><td>Collects very limited information; some relate to the topic</td><td>Collect much information; but very limited relate to the topic</td><td>Collects some basic information; most refer to the topic</td><td>Collects a great deal of information; all refer to the topic</td><td>Ex: 4</td></tr>
<tr><td>**Fulfill team's roles & duties**</td><td>Does not perform any duties assigned to the team role</td><td>Performs very little duties but unreliable.</td><td>Performs very little duties</td><td>Performs nearly all duties</td><td>Performs all duties of assigned team roles</td><td>5</td></tr>
<tr><td>**Shares work equally**</td><td>Always relies on others to do the work</td><td>Rarely does the assigned work; often needs reminding</td><td>Usually does the assigned work; rarely needs reminding</td><td>Normally does the assigned work</td><td>Always does the assigned work without having to be reminded.</td><td>3</td></tr>
<tr><td>**Listen to other Team mates**</td><td>Is always talking; never allows anyone else to speak</td><td>Usually does most of the talking; rarely allows others to speak</td><td>Talks good; but never show interest in listening others</td><td>Listens, but sometimes talk too much</td><td>Listens and speaks a fair amount</td><td>2</td></tr>
<tr><td colspan="6">Average / Total marks=(4+5+3+2)/4=14/4=3.5=4</td><td></td></tr>
</table>

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VSEM	**MECHATRONICS**	20
	Year: 2016-17	Course code:15ME54T	

Name of Course coordinator :   Units:1,2 Co: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Classify the sensors and transducers	5	U	1	2
2	Define the terms: range and span, repeatability, stability, resolution, output impedance OR List the factors for selection of sensors	5	R	1	2
3	Build Decoder with seven segment display	5	A	2	2
4	Make use of sketch explain weighted-resistor DAC OR Make use of sketch explain successive approximation ADC.	5	A	2	2

Diploma in Mechanical Engineering
V- Semester
MECHATRONICS

Note; Answer 6 questions from part A & Any 7 from Part B

PART-A   6x5=30

1. Explain with a line diagram the function of each element of a measurement system
2. Why T-Flip-Flops are most commonly used in counters?
3. List different data presentation elements
4. Explain Hydrostatic, solid film and boundary layer bearing.
5. Explain briefly Adaptive Control and its three stages of operations.
6. Explain briefly protocols and its elements.
7. List the selection factors of PLC.
8. Explain briefly protocols and its elements.
9. What are the Specifications of stepper motor?
10. List the performance features of sensors and transducers

PART-B   7x10=70

1. Make use of a sketch to explain the working of a diaphragm pressure gauge.
2. Make use of a sketch to explain coded digital signal to a set of Traffic Lights
3. Make use of a sketch to explain the working of Laser printer.
4. Make use of a sketch to explain Zener diode protection circuit
5. Make use of a sketch to explain Digital closed-loop Control system.
6. Make use of a sketch to explain model of building up a thermal system.
7. Make use of a sketch to explain rotary potentiometer.
8. Build a ladder programming and list its sequences with line diagram
9. Explain Continuous and discrete process Control processes.
10. Make use of a sketch to explain design of Car Park barrier System.
11. Explain briefly
    a. Centralized computer control
    b. Hierarchical system
    c. Distributed system

MODEL QUESTION BANK

Diploma in Mechanical Engineering
V Semester
Course Title: MECHATRONICS

CO I. Discuss the importance of mechatronics systems and know the usage of Sensors and Transducers for automation applications

REMEMBER QUESTIONS

1) Define Mechatronics?
2) Define system with example.
3) Define sensors and transducers with an example.
4) List the factors for selection of sensors.
5) Define the terms: range and span, error, accuracy, sensitivity, hysteresis error, non-linearity error, repeatability/reproducibility, stability, dead band/time, resolution, output impedance.
6) List the performance features of sensors and transducers.

UNDERSTANDING QUESTIONS

1) Explain the importance of mechatronics.
2) Explain with a block diagram the measurement system.
3) Explain control systems and their types.
4) Classify the sensors and transducers.
5) Explain sensors for displacement, position and proximity.
6) Explain the working of light sensors.

APPLICATION QUESTIONS

1) Make use of a sketch to explain the working of pneumatic sensors.
2) Build a line diagram and explain the function of each element of a measurement system.
3) Make use of a sketch to explain the working of proximity switches.
4) Make use of a sketch to explain the working of optical encoder.
5) Make use of a sketch to explain the Hall Effect sensors.
6) Make use of a sketch to explain the working of tachogenerator.
7) Make use of a sketch to explain sketch bimetallic strip/thermostat.
8) Make use of a sketch to explain the working of a diaphragm pressure gauge.
9) Make use of a sketch to explain strain gauge load cell.
10) Make use of a sketch to explain piezoelectric sensor.
11) Make use of a sketch to explain turbine meter.
12) Make use of a sketch to explain float type liquid level meter.
13) Make use of a sketch to explain the working of LVDT.
14) Make use of a sketch to explain the bimetallic strips.

CO 2: Acquire the knowledge of combinational and sequential logic circuits

LEVEL: REMEMBER

1) Define analog signal.
2) What are Digital signals?
3) List different data presentation elements.
4) List different printers.
5) List the selection of DAQ criteria.
6) List the Applications of logic gates.

LEVEL: UNDERSTANDING

1) Explain briefly BCD system.
2) Explain briefly various data presentation elements.
3) Explain briefly data acquisition system.
4) Explain display.

LEVEL: APPLICATION

1. Make use of a sketch to explain briefly weighted-resistor DAC
2. Make use of a sketch to explain the successive approximation ADC.
3. Construct the truth table for the following logic gates
   a. AND gate
   b. OR gate
   c. NOT gate
   d. NOR gate.
   e. NAND gate
   f. XOR gate.
4) Make use of a sketch to explain coded digital signal to a set of Traffic Lights.
5) Make use of a sketch to explain sequential logic system.
6) Make use of a sketch to explain following Flipflops.
   a. Flip Flops.
   b. SR.
   c. JK.
   d. D Flip Flops.
   e. Registers.
7) Make use of a sketch to explain dot matrix print head mechanism.
8) Make use of a sketch to explain basic elements of a laser printer.
9) Make use of a sketch to explain Decoder with seven segment display.
10) Make use of a sketch to explain LCD.

C0 03: Know various actuation systems and understand the working of mechanical, electrical, hydraulic actuation systems.

LEVEL: REMEMBER

1) Define a bearing.

2) List the uses of bearings.
3) List all types of bearings.
4) List different types of solid state switches.
5) List Different types of DC motors.
6) List Different types of AC motors.
7) Define stepper motor.
8) List different types of stepper motors.
9) List the terms commonly used for specifying stepper motors.

LEVEL: UNDERSTANDING

1) Explain Hydrostatic, solid film and boundary layer bearing.
2) Explain in brief electrical systems.
3) Explain the terms commonly used for specifying stepper motors.

LEVEL: APPLICATION

1) Make use of a sketch to explain simple sensor actuation system.
2) Make use of a sketch to explain principle of the Ratchet and Pawl.
3) Make use of a sketch to explain basic elements of ball and roller bearings.
4) Make use of a sketch to explain plain journal bearing.
5) Make use of a sketch to explain Hydrodynamic bearing.
6) Make use of a sketch to explain relays.
7) Make use of a sketch to explain diodes.
8) Make use of a sketch to explain MOSFETs.
9) Make use of a sketch to explain solenoids.
10) Make use of a sketch to explain the basic working principle of DC motor.
11) Make use of a sketch to explain the basic working principle of AC motor.

CO 04: Design the Building blocks of Mechanical, Electrical, Fluid and Thermal Systems.

LEVEL: REMEMBER

1) List different Control Modes.

LEVEL: UNDERSTANDING

1) Explain briefly the necessity of mathematical models.
2) Explain electrical system building blocks.
3) Explain thermal system building blocks
4) Explain electromechanical system.
5) Explain hydraulic-mechanical system.
6) Explain Continuous and discrete process Control processes.
7) Explain briefly Control Modes.
8) Explain briefly Adaptive Control and its three stages of operations.

1) Make use of a sketch to explain different mechanical building block systems like spring, dashpot and mass.
2) Make use of a line diagram to explain model of building up a spring -dashpot-mass mechanical system.
3) Make use of a line diagram to explain model of building up a resister -inductor-capacitor electrical system.
4) Make use of a sketch to explain model of building up a thermal system.
5) Make use of a sketch to explain the rotational-translational system.
6) Make use of a sketch to explain rotary potentiometer.
7) Make use of a sketch to explain hydraulic system and load (without derivation).
8) Make use of a sketch to explain Digital closed-loop Control system.
9) Make use of a sketch to explain Velocity Control.

CO 05: Describe the significance of PLC for automation

LEVEL: REMEMBER

1. List the different types of memories.
2. Define Microprocessor.
3. Define Microcontroller.
4. Define PLC.
5. List Input/output processing.
6. Define counter.
7. List the use of master relay.
8. List the selection factors of PLC.

LEVEL: UNDERSTANDING

1) Classify Memories.
2) Explain the following :
   a. RAM, b. ROM, c. PROM, d. EPROM, e. EEPROM
3) Explain the architecture of Microprocessor.
4) Explain the architecture of microcontroller.
5) Compare Microprocessor and Microcontroller.
6) Explain with sketch architecture of PLC
7) Explain Input/output processing.
8) Explain ladder programming and its sequences with line diagram.
9) Explain ladder program with ladder diagram.
10) Infer the mnemonics used in PLC.
11) Explain shift registers.
12) Explain briefly data handling.

LEVEL: APPLICATION

1) Construct the ladder diagram for following functions.
   a. Delay-on timer
   b. On-delay timer(TON)
   c. Timing with off-delay(TOFF)
2) Construct a ladder diagram for input/output of counters and various ways of representing the same.

3) Construct a PLC ladder diagram for Master Control Relay.

4) Construct a PLC ladder diagram for Jumps.

CO 06: Know the importance of communication systems and its interface and Design the Mechatronics Systems.

LEVEL: REMEMBER
1) List different types of networks.
2) List different types of network layers.

LEVEL: UNDERSTANDING
1) Explain briefly the role of digital communications.
2) Explain briefly
   a. Centralized computer control
   b. Hierarchical system
   c. Distributed system
3) Explain different types of networks.
4) Explain briefly protocols and its elements.
5) Explain briefly the open system interconnection communication model.
6) Explain briefly different network layers.
7) Explain briefly serial and parallel interfaces.

LEVEL: APPLICATION

1. Make use of a neat sketch to explain Car Park barrier System.
2. Make use of a neat sketch to explain of Engine Management Systems.
3. Make use of a neat sketch to explain design of hard disc drive.