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COURSE PLAN

Academic Year 2019 – 20

Program:	B E – MECHANICAL
Semester :	VII
Course Code:	15ME753
Course Title:	MECHATRONICS
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	50
Course Plan Author:	DINESH P

Academic Evaluation and Monitoring Cell

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Note : Remove “Table of Content” before including in CP Book

Each Course Plan shall be printed and made into a book with cover page

Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

15ME753 : Mechatronics

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	ME
Year / Semester :	4/VII	Academic Year:	2019-20
Course Title:	MECHATRONICS	Course Code:	15ME753
Credit / L-T-P:	3/3-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50	SEE Marks:	80Marks
CIA Marks:	20	Assignment	1 / Module
Course Plan Author:	Mr. DINESH P	Sign	Dt:
Checked By:		Sign	Dt:

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Module Content	Teaching Hours	Module Concepts	Bloom's Level
1	Introduction:Definition, Multidisciplinary Scenario, Evolution of Mechatronics,Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics. Transducers and sensors:Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors.	10	Inter disciplinary system	L2
2	Microprocessor & Microcontrollers:Introduction, Microprocessor systems,Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers. Microprocessor Architecture: Microprocessor architecture and terminology-CPU,memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.	10	Architecture	L2
3	Programmable logic controller:Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching &selection of a PLC. Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.	10	Logic control	L2
4	Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motor selection. Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.	10	Actuators	L3

	Electrical actuation systems:Electrical systems, Mechanical switches, Solenoids,Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.			
5	Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Cylinders and rotary actuators. DCV & FCV: Principle & construction details, types of sliding spool valve, solenoid operated, Symbols of hydraulic elements, components of hydraulic system, functions of various units of hydraulic system. Design of simple hydraulic circuits for various applications.	10	Working Principles	L3

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Module	Details	Available
A	Text books (Title, Authors, Edition, Publisher, Year.)	
1,2,3,4,5	W.Bolton-Pearson Education, Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, 1 st Edition, 2005	In Lib
B	Reference books (Title, Authors, Edition, Publisher, Year.)	
1,2,3,4,5	Mechatronics & Microprocessor by Dr. H D Ramchandra	In Dept
C	Concept Videos or Simulation for Understanding	
C1	Introduction https://youtu.be/Zla-D7wOvO4	
C2	Transducers and sensors https://www.youtube.com/watch?v=nSeW3R2hr1A	
C3	Microprocessor & Microcontrollers https://www.youtube.com/watch?v=6R7JDkpG1Wk&list=PLrjkTql3jnm8HbdMwBYIMAd3UdstWChFH	
C4	Microprocessor Architecture https://www.youtube.com/watch?v=XEMyFUuV31o	
C5	Programmable logic controller https://www.youtube.com/watch?v=Q7kA7uv4dn4	
C6	Integration https://www.youtube.com/watch?v=n6nxTBB16ag	
C7	Mechanical actuation systems https://www.youtube.com/watch?v=EF7A37Keprc	
C8	Electrical actuation systems https://www.youtube.com/watch?v=s0cJTlu_L2c	
C9	Pneumatic and hydraulic actuation systems https://www.youtube.com/watch?v=Mumydsarx3c	
C10	DCV & FCV https://www.youtube.com/watch?v=XDyTPlkwKak	
D	Software Tools for Design	
	https://www.youtube.com/watch?v=pWsmIhQIoa8	

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	15CCP13	Computer concepts & Programming	Microprocessor	I/II		L2

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Construction and working of a sensors	Higher Study	Gap	Understand L2
2	Detail study of interrupts	Higher Study	Gap	Understand L2
3	SCARA Robots	Higher Study	Gap	Understand L2

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

#	Cos students should be able to...	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
15ME753.1	Student will be able to understand multi disciplinary systems	3	Inter disciplinary system	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.2	Student will be able to understand working principles of transducer and sensors	7	Components	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.3	Student will be able to understand microprocessors and controllers	4	Processors	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.4	Student will be able to understand the architecture of microprocessor	6	Architecture	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.5	Student will be able to understand the logic controllers	5	Logic Control	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.6	Student will be able to understand concepts of automations	5	Integration	Chalk and Board	Assignment, Unit test and IA	L2 Understand
15ME753.7	Student will be able to understand mechanism of mechanical actuators	5	Mechanisms	Chalk and Board	Assignment, Unit test and IA	L3 Apply
15ME753.	Student will be able to understand	5	Components	Chalk and	Assignment,	L3 Apply

8	mechanism of electrical actuators			Board	Unit test and IA	
15ME753.9	Student will be able to understand concepts of hydraulic and pneumatic systems	5	Actuators	Chalk and Board	Assignment, Unit test and IA	L3 Apply
15ME753.10	Student will be able to understand constructional features	5	Working principles	Chalk and Board	Assignment, Unit test and IA	L3 Apply

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Multi functional	CO1	L2
1	Precision works	CO2	L2
2	Development	CO3	L2
2	Structure design	CO4	L2
3	Integration	CO5	L2
3	Automation	CO6	L2
4	Processing industries	CO7	L3
4	Actuation	CO8	L3
5	Fluid power	CO9	L3
5	Circuit design	CO10	L3

4. Mapping Justification

Mapping		Justification	Mapping Level
CO	PO	-	-
CO1	PO1	Knowledge of engineering fundamentals is required to understand the multidisciplinary scenario.	L2
CO1	PO2	Analysing the different multidisciplinary systems.	L2
CO2	PO1	Knowledge of engineering science is required to understand the mechatronics systems.	L2
CO2	PO2	Analysing the different principles and working of mechatronics systems.	L2
CO3	PO1	Knowledge of engineering science is required to understand the microprocessor and micro controller systems.	L2
CO3	PO2	Analysing the different elements of control systems.	L2
CO4	PO1	Knowledge of terminologies of microprocessor is required to understand the architecture system.	L2
CO4	PO2	Analysing the different microprocessors	L2
CO5	PO1	Knowledge of memory devices and logic functions	L2
CO5	PO2	Analysing the different programmable logic diagrams	L2
CO6	PO1	Knowledge of controlling devices.	L2
CO6	PO2	Analysing the different actuators.	L2
CO7	PO1	Knowledge of actuator	L3
CO7	PO2	Analysing the working of different mechanical actuation systems.	L3
CO8	PO1	Knowledge of electrical systems is required to understand the different actuation systems	L3
CO8	PO2	Analysing the working of different electrical actuation systems.	L3
CO9	PO1	Knowledge of engineering science required to understand the different Pneumatic and hydraulic systems.	L3
CO9	PO2	Analysing the working of different Pneumatic and hydraulic actuation systems.	L3

CO10	PO1	Knowledge of engineering science required to understand the different control valves.	L3
CO10	PO2	Analysing the principle and working of different control valves.	L3

Note: Write justification for each CO-PO mapping.

4. Articulation Matrix

(CO – PO MAPPING)

Modules	#	Course Outcomes Cos	Program Outcomes															Level	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3		
1	15ME753.1	Student will be able to understand multi disciplinary systems	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
1	15ME753.2	Student will be able to understand working principles of transducer and sensors	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
2	15ME753.3	Student will be able to understand microprocessors and controllers	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
2	15ME753.4	Student will be able to understand the architecture of microprocessor	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
3	15ME753.5	Student will be able to understand the logic controllers	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
3	15ME753.6	Student will be able to understand concepts of automation	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
4	15ME753.7	Student will be able to understand mechanism of mechanical actuators	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L3
4	15ME753.8	Student will be able to understand mechanism of electrical actuators	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L3
5	15ME753.9	Student will be able to understand concepts of hydraulic and pneumatic systems	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L3
5	15ME753.10	Student will be able to understand constructional features	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L3
-	15ME753	Average attainment (1, 2, or 3)	2.1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	PO, PSO	<i>1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design</i>																	

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Construction and working of a sensors	Seminar	3 rd week / date	Dr XYZ, Inst	List from B4 above
2					
3					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
2	Detail study of interrupts	Placement, GATE, Higher Study, Entrepreneurship.	Presentation by students	5 th week / date	Dr ABC, Inst. Self	List from B4 above
4	SCARA Robots	Placement, GATE, Higher Study, Entrepreneurship.	Presentation by students	11 th week / date	Dr ABC, Inst. Self	List from B4 above

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Module #	Title	Teaching Hours	No. of question in Exam					CO	Levels	
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg			SEE
1	Introduction to Mechatronics	10	2	-	-	1	-	2	CO1, CO2	L2
2	Microprocessor & Micro controllers	10	2	-	-	1	-	2	CO3, CO4	L2
3	Programmable logic controller	10	-	2	-	1	-	2	CO5, CO6	L2,
4	Mechanical actuation systems	10	-	2	-	1	-	2	CO7, CO8	L3
5	Pneumatic and hydraulic actuation systems	10	-	-	4	1	-	2	CO9, CO10	L3
-	Total	50	4	4	4	5	-	10	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	15	CO1, CO2, CO3, CO4	L2
CIA Exam – 2	15	CO5, CO6, CO7, CO8	L2, L3
CIA Exam – 3	15	CO9, CO10	L3
Assignment - 1	05	CO1, CO2, CO3, CO4	L2

Assignment - 2	05	CO5, CO6, CO7, CO8	L2, L3
Assignment - 3	05	CO9,CO10	L3
Seminar - 1			
Seminar - 2			
Seminar - 3			
Other Activities – define – Slip test			
Final CIA Marks	20	-	-

D1. TEACHING PLAN - 1

Module - 1

Title:	Introduction, Transducers and sensors	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Understand multi disciplinary systems	CO1	L2
2	Understand working principles of transducer and sensors	CO2	L2
b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
1	Introduction: Definition Multidisciplinary Scenario	CO1	L2
2	Evolution of Mechatronics,	CO1	L2
3	Design of Mechatronics system	CO1	L2
4	Objectives, advantages and disadvantages of Mechatronics.	CO1	L2
5	Transducers and sensors: Definition and classification of transducers,	CO2	L2
6	Difference between transducer and sensor,	CO2	L2
7	Definition and classification of sensors	CO2	L2
8	Principle of working and applications of light sensors	CO2	L2
9	Proximity switches	CO2	L2
10	Hall Effect sensors.	CO2	L2
c	Application Areas	CO	Level
1	Multi functional	CO1	L2
2	Precision works	CO2	L2
d	Review Questions	-	-
1	Define mechatronics. State the major differences between conventional and mechatronics product design approach.	CO1	L2
2	What is sequential controller and explain with a block diagram the working of domestic washing machine.	CO1	L2
3	Discuss any four of the following with neat sketch and an example: (I) Mechatronics (ii) Open loop control system. (iii) Closed loop control system (iv) Measurement system. (v) Transducers.	CO1	L2
4	Define Mechatronics. With a block diagram, briefly explain the generalized measurement system.	CO1	L2
5	Explain with a diagram, the working of an Engine Management system	CO1	L2
6	Define the following transducers with examples:	CO2	L2

	(I) Analog transducer. (ii) Digital transducer. (iii) Active transducer. (iv) Passive transducer. (v) Mechanical transducer.		
7	Explain with a neat diagram, (i) Capacitive proximity sensor. (ii) Principle of Hall effect	CO2	L2
8	List the application of light sensors	CO2	L2
9	Explain the operation of a linear variable differential transducer.	CO2	L2
10	What are position sensors? Explain the working of Hall effect sensors and mention the advantages of it.	CO2	L2
e	Experiences	-	-
1			
2			
3			
4			
5			

Module – 2

Title:	Microprocessor & Microcontrollers	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Understand microprocessors and controllers	CO3	L2
2	Understand the architecture of microprocessor	CO4	L2
b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
1	Microprocessor & Microcontrollers: Introduction, Microprocessor systems	CO3	L2
2	Basic elements of control systems.	CO3	L2
3	Microcontrollers	CO3	L2
4	Difference between Microprocessor and Microcontrollers.	CO3	L2
5	Microprocessor Architecture: Microprocessor architecture ,	CO4	L2
6	Terminology-CPU, memory and address, I/O and Peripheral devices	CO4	L2
7	ALU, Instruction and Program, Assembler, Data,	CO4	L2
8	Registers, Program Counter, Flags, Fetch cycle	CO4	L2
9	Write cycle, state, bus interrupts.	CO4	L2
10	Intel's 8085A Microprocessor.	CO4	L2
c	Application Areas	CO	Level
1	Development	CO3	L2
2	Structure design	CO4	L2
d	Review Questions	-	-
1	With the help of a block diagram, explain briefly the general form of a microprocessor system.	CO3	L2

2	State and explain functions of basic elements of a closed loop control system, with a block diagram.	CO3	L2
3	What are micro controllers? Explain the general form of a micro controller.	CO3	L2
4	Differentiate between Microprocessor and microcontrollers	CO3	L2
5	Define the following terms with respect to microprocessor: i) Fetch cycle ii) Accumulator iii) Interrupts iv) Stack pointer v) Write cycle.	CO4	L2
6	Explain in detail with a block diagram, the architecture of Intel 8085 A microprocessor	CO3	L2
7	With a neat flow chart, discuss the programming process.	CO4	L2
8	Distinguish between instruction cycle, machine cycle and T-state.	CO4	L2
9	Draw and explain the timing diagram for opcode fetch operation.	CO4	L2
d	Review Questions	-	-
e	Experiences	-	-
1			
2			
3			
4			
5			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	15ME753	Sem:	VII	Marks:	15	Time:	75 minutes	
Course:	Mechatronics							
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	What are the benefits of mechatronics in industries?				5	CO1	L2
	b	Define mechatronics. What are the advantages and disadvantages of mechatronics?				5	CO1	L2
	c	Explain with a block diagram the working of a digital camera.				5	CO1	L2
		OR						
2	a	Define Sensors and Transducers. Name any three types of sensors and transducers each.				5	CO4	L2
	b	Explain capacitive proximity sensor, with a neat diagram				5	CO4	L2
	c	State and explain the working principle of Hall Effect sensor.				5	CO4	L2
3	a	What are the basic functions of control system? Mention the requirement of it in detail.				6	CO3	L2
	b	What are micro controllers? Explain the general form of a micro controller.				6	CO3	L2
	c	Differentiate between Microprocessor and microcontrollers				3	CO3	L2
		OR						
4	a	Write the functional block diagram of INTEL 8085 microprocessor and explain 3 important sections of microprocessors.				5	CO4	L2
	b	Briefly explain with sketch: (i) Instruction register (IR) (ii) Data register				5	CO4	L2

c	Explain the following terminology related to microprocessor : i) Program counter ii) Flag register	5	CO4	L2
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b. Assignment -1

Model Assignment Questions								
Crs Code:	15ME753	Sem:	VII	Marks:	5	Time:	75 minutes	
Course:	Mechatronics							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1		What is a Microcontroller? How are microcontrollers classified?				5	CO1	L2
2		What are the advantages and disadvantages of mechatronics?				5	CO1	L2
3		Briefly explain classification of microcontrollers				5	CO1	L2
4		Explain with a block diagram the working of a digital camera.				5	CO1	L2
5		Explain the operation of a linear variable differential transducer.				5	CO2	L2
6		What are proximity sensors? Explain capacitive proximity sensor, with a neat diagram				5	CO2	L2
7		Explain static and dynamic characteristics of sensors				5	CO2	L2
8		Explain working principle of Hall effect sensor.				5	CO2	L2
9		Differentiate between transducers and sensors				5	CO2	L2
10		Briefly explain classification of sensors				5	CO2	L2
11		Discuss basic elements of a closed-loop system.				5	CO3	L2
12		Explain the following performance terminologies of transducers: i) Accuracy ii) Repeatability iii) Drift iv) Speed of response				5	CO4	L2
13		Draw the block diagram of a micro controller and mention the functions of each block.				5	CO4	L2
14		What is the function of logical group of instructions and mention few of it.				5	CO4	L2
15		Explain the following terminology related to microprocessor: i) Interrupts ii) RAM iii) Assembler				5	CO4	L2
16		Write the functional block diagram of INTEL 8085 microprocessor and explain 3 important sections of microprocessors.				5	CO4	L2
17		Explain with a neat sketch of architecture 8085A microprocessor.				5	CO4	L2
18		Explain the following terminology related to microprocessor : i) Program counter ii) Flag register iii) Stack pointer iv) Accumulator.				5	CO4	L2
19		Explain the flow of instruction sets of 8085A microprocessor.				5	CO4	L2
20		List out the functions of ALU.				5	CO4	L2
21		Explain any four applications of microprocessor.				5	CO4	L2

D2. TEACHING PLAN - 2

Module – 3

Title:	Programmable logic controller	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Understand concepts of automations	CO5	L2
2	Understand mechanism of mechanical actuators	CO6	L2
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Programmable logic controller: Introduction to PLC's	CO5	L2
2	Basic structure of PLC	CO5	L2
3	Principle of operation of PLC	CO5	L2
4	Programming and concept of ladder diagram	CO5	L2
5	Concept of latching & selection of a PLC.	CO5	L2
6	Integration: Introduction & background	CO6	L2
7	Advanced actuators, Pneumatic actuators	CO6	L2
8	Industrial Robot, different parts of a Robot-Controller	CO6	L2
9	Drive, Arm, End Effectors	CO6	L2
10	Sensor & Functional requirements of robot.	CO6	L2
c	Application Areas	CO	Level
1	Integration	CO5	L2
2	Automation	CO6	L2
d	Review Questions	-	-
1	Draw and explain the structure of a programmable logic controller	CO5	L2
2	Explain the principle of PLC	CO5	L2
3	Explain the operation of PLC	CO5	L2
4	Explain the programming of ladder diagram	CO5	L2
5	Explain the concept of latching	CO5	L2
6	Describe the concepts of advanced actuator	CO6	L2
7	Explain the concept of pneumatic actuators	CO6	L2
8	List the application of robotics	CO6	L2
9	Explain different parts of robot controller	CO6	L2
10	Explain functional requirements of robots	CO6	L2
e	Experiences	-	-
1			
2			
3			
4			
5			

Module – 4

Title:	Mechanical actuation systems	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Understand mechanism of mechanical actuators	CO7	L3

2	Understand mechanism of electrical actuators	CO8	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Mechanical actuation systems: Mechanical systems	CO7	L3
2	Types of motion, Cams, Gear trains	CO7	L3
3	Ratchet & Pawl	CO7	L3
4	Belt and chain drives	CO7	L3
5	mechanical aspects of motor selection	CO7	L3
6	Electrical actuation systems: Electrical systems, Mechanical switches,	CO8	L3
7	Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.	CO8	L3
8	Electrical actuation systems: Electrical systems, Mechanical switches	CO8	L3
9	Solenoids, Relays, DC/AC Motors	CO8	L3
10	Principle of Stepper Motors & servomotors.	CO8	L3
c	Application Areas	CO	Level
1	Processing industries	CO7	L3
2	Actuation	CO8	L3
d	Review Questions	-	-
1	Explain the types of motion	CO7	L3
2	Explain the principle of cam mechanism	CO7	L3
3	Explain gear trains mechanism	CO7	L3
4	Explain ratchet and pawl mechanism	CO7	L3
5	Explain belt and chain drives mechanism	CO7	L3
6	Explain the working principle of a permanent magnet D.C. motor. How it is used for positive control drives?	CO7	L3
7	Sketch and explain the working of stepper motor.	CO7	L3
8	What are solid state switches? Discuss any four solid state switches.	CO8	L3
9	Explain the working principle of, (i) Permanent magnet DC motor. (ii) Permanent magnet stepper motor.	CO8	L3
10	What are solenoids? What are the parameters to be consider for selecting a solenoids for an application.	CO8	L3
e	Experiences	-	-
1			
2			
3			
4			
5			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	15ME753	Sem:	VII	Marks:	15	Time:	75 minutes	
Course:	Mechatronics							
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	Explain the functions of each block of PLC.				5	CO5	L2
	b	Explain the operation of PLC				5	CO5	L2
	c	Explain ladder diagram				5	CO5	L2
		OR						
2	a	What are the types of pneumatic actuators				5	CO6	L2
	b	What are the types of advanced actuators				5	CO6	L2

	c	Explain the concepts of drive and arm	5	CO6	L3
3	a	With sketch, explain solenoid and state its uses.	5	CO7	L3
	b	What is stepper motor and explain the working of a two stack stepper motor.	5	CO7	L3
	c	Explain the theory of DC motor speed control	5	CO7	L3
		OR			
4	a	Explain the principle of stepper motor	5	CO8	L3
	b	Explain the mechanical aspects of motor selection	5	CO8	L3
	c	Explain the mechanism of electrical system	5	CO8	L3

b. Assignment – 2

Model Assignment Questions								
Crs Code:	15ME753	Sem:	VII	Marks:	5	Time:	75 minutes	
Course:	Mechatronics							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1		Explain programmable logic controller				5	CO5	L3
2		Explain the selection of PLC				5	CO5	L3
3		Explain the operation of PLC				5	CO5	L3
4		Explain the concept of ladder diagram				5	CO5	L3
5		Explain the principle of latching				5	CO5	L3
6		Explain the types of pneumatic actuators				5	CO6	L3
7		Explain the types of advanced actuators?				5	CO6	L3
8		Briefly explain the application of industrial robot				5	CO6	L3
9		Explain the concepts of robot controller				5	CO6	L3
10		Explain end effectors.				5	CO6	L3
11		Explain the mechanism of mechanical systems				5	CO7	L3
12		Explain the classification of types of motion				5	CO7	L3
13		Explain the concepts of cam and cam follower				5	CO7	L3
14		Explain gear trains mechanism				5	CO7	L3
15		Explain ratchet and pawl mechanism				5	CO7	L3
16		Explain belt and chain drives mechanism				5	CO7	L3
17		Explain the types of solenoids				5	CO8	L3
18		Discuss any four solid state switches.				5	CO8	L3
19		What is stepper motor? Explain various types of stepper motor				5	CO8	L3
20		Explain the working principle of a permanent magnet D.C. motor. How it is used for positive control drives?				5	CO8	L3

D3. TEACHING PLAN - 3

Module – 5

Title:	Pneumatic and hydraulic actuation systems	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Understand concepts of hydraulic and pneumatic systems	CO9	L3
2	Understand constructional features	CO10	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Pneumatic and hydraulic actuation systems: Actuating systems,	CO9	L3
2	Pneumatic and hydraulic systems	CO9	L3
3	Classifications of Valves, Pressure relief valves,	CO9	L3
4	Pressure regulating/reducing valves	CO9	L3
5	Cylinders and rotary actuators	CO9	L3
6	DCV & FCV: Principle & construction details	CO10	L3
7	Types of sliding spool valve, solenoid operated	CO10	L3
8	Symbols of hydraulic elements, components of hydraulic system	CO10	L3
9	Functions of various units of hydraulic system.	CO10	L3
10	Design of simple hydraulic circuits for various applications.	CO10	L3
c	Application Areas		
1	Fluid power	CO9	L3
2	Circuit design	CO10	L3
d	Review Questions		
1	What are the advantages of hydraulic system	CO9	L3
2	With a neat block diagram, explain the structure of hydraulic power system.	CO9	L3
3	Explain with neat sketch of pilot operated pressure Relief valve.	CO9	L3
4	Write any five desirable properties of a hydraulic fluid.	CO9	L3
5	Sketch and explain structure of pneumatic control system.	CO9	L3
6	Explain with neat sketch of circuit of sequencing of two pneumatic cylinder that can be done by using Solenoids, limit switches and valves.	CO10	L3
7	Explain the pressure dependent control of circuit with a 5/2 double pilot operated DCV, two 3/2 spring return and double acting cylinder.	CO10	L3
8	Explain with a neat circuit diagram, the working of double pump hydraulic system.	CO10	L3
9	Explain with a neat circuit diagram, the counter balance valve application.	CO10	L3
10	With circuit diagram explain the application of accumulator as hydraulic shock absorber.	CO10	L3
e	Experiences	-	-
1			
2			
3			
4			
5			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	15ME753	Sem:	VII	Marks:	15	Time:	75 minutes
Course:	Mechatronics						

-	-	Note: Answer any 2 questions, each carry equal marks.	Marks	CO	Level
1	a	Explain pressure reducing valve with graphical symbol.	5	CO9	L2
	b	With circuit diagram explain meter in circuit for controlling the speed of hydraulic cylinders.	5	CO9	L2
	c	State Pascal's law? With a neat sketch explain the basic hydraulic power system	5	CO9	L2
		OR			
2	a	Describe with a circuit diagram the construction and working of a counter balance valve in hydraulic circuit	6	CO9	L2
	b	What are the types of pneumatic actuators? With sketch explain the construction and working principle of single acting cylinder.	6	CO9	L2
	c	Differentiate hydraulic and pneumatic system.	3	CO9	L2
3	a	Explain quick exhaust valve with circuit diagram	5	CO9	L2
	b	With a neat sketch, explain Hydraulic circuit for sequencing of Two cylinders.	5	CO9	L2
	c	Sketch and explain structure of a hydraulic control system	5	CO9	L2
		OR			
4	a	Briefly classify valves based on the type of function performed.	5	CO9	L2
	b	What are flow control valves? Draw graphical symbols for F.C.V.	5	CO9	L2
	c	What are the advantages, limitations and applications of hydraulic systems?	5	CO9	L3

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	15ME753	Sem:	VII	Marks:	5 / 10	Time:	75 minutes
Course:	Mechatronics						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							
SNo	USN	Assignment Description			Marks	CO	Level
1		With a schematic diagram, explain the working of simple pressure relief valve.			5	CO9	L3
2		Write a note on direct and indirect actuation of pneumatic cylinders.			5	CO9	L3
3		Explain with a neat sketch construction and operation of simple pressure relief valve.			5	CO9	L3
4		Give the difference between hydraulic and pneumatic system			5	CO9	L3
5		Explain with Hydraulic circuit, how speed control can be achieved in Hydraulic motor.			5	CO9	L3
6		Sketch and explain a cushion assembly for a pneumatic cylinder.			5	CO9	L3
7		With the aid of a circuit, explain how the sequencing of two pneumatic cylinders can be done by using solenoids, limit switches and valves			5	CO9	L3
8		Explain with a neat circuit diagram, the working of double pump hydraulic system			5	CO9	L3
9		With a neat sketch explain the working of linear actuator for single acting cylinder			5	CO9	L3
10		What are the types of pneumatic actuators? With sketch explain the construction and working principle of single acting cylinder			5	CO9	L3
11		With sketch briefly explain linear hydraulic actuators.			5	CO10	L3
12		Explain with a neat sketch the working of four way, two position directional control valve with symbolic representation			5	CO10	L3
13		Explain with a neat sketch construction and operation			5	CO10	L3

		of simple pressure relief valve.			
14		Explain with a neat circuit diagram the working of a regenerative circuit	5	CO10	L3
15		Explain with a neat sketch construction and operation of a typical quick exhaust valve to increase the actuation speed of a cylinder in a pneumatic system.	5	CO10	L3
16		Explain the Motion control diagram for a 2 cylinder circuit.	5	CO10	L3
17		Write a note on relays used in electro pneumatic control.	5	CO10	L3
18		Sketch and explain the operation of a hydraulic circuit for the control of a spring return-single acting cylinder	5	CO10	L3
19		Sketch and explain any two types of spool valve	5	CO10	L3
20		Sketch and explain solenoid operated DCV	5	CO10	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:		Mechatronics				Month / Year		Dec /2019	
Crs Code:		15ME753	Sem:	VII	Marks:	80	Time:		180 minutes
-	Note	Answer all FIVE full questions. All questions carry equal marks.					Marks	CO	Level
1	a	Explain the objectives of mechatronics					6	CO1	L2
	b	Explain the working principle of Hall Effect sensor.					6	CO1	L2
	c	List the advantages and disadvantages of mechatronics					4	CO1	L2
		OR							
2	a	Explain the design of mechatronics system					6	CO4	L2
	b	Define Sensors and Transducers. Name any three types of sensors and transducers each.					6	CO4	L2
	c	List the application of light sensors					4	CO4	L2
3	a	Explain microprocessor system					5	CO3	L2
	b	Briefly explain elements of closed-loop control system					7	CO3	L2
	c	Differentiate between Microprocessor and micro controllers					4	CO3	L2
		OR							
4	a	What are micro controllers? Explain the general form of a micro controller.					5	CO4	L2
	b	Explain the architecture Intel's 8085A					6	CO4	L2
	c	Define the following terms with respect to microprocessor: i) Fetch cycle ii) Accumulator iii) Interrupts iv) Stack pointer v) Write cycle.					5	CO4	L2
5	a	Explain the programming of ladder diagram					6	CO5	L2
	b	Explain the concept of latching					5	CO5	L2
	c	Explain basic structure of PLC					4	CO5	L2
		OR							
6	a	Write a note on i)advanced actuators ii) Pneumatic actuators					6	CO6	L2
	b	Explain different parts of a robot controller					6	CO6	L2
	c	List out the application of robot					4	CO6	L3
7	a	Briefly explain types of motion					7	CO7	L3
	b	Write short note on i) Cams ii) Gear trains iii) Ratchet & Pawl					9	CO7	L3
		OR							
8	a	Explain electrical systems and mechanical systems					7	CO8	L3
	b	Write short note on i) Solenoids ii) Relays iii) servomotors					9	CO8	L3

9	a	Explain actuation systems	4	CO9	L3
	b	Explain cylinder actuators	4	CO9	L3
	c	Explain Pressure regulating valves	4	CO9	L3
OR					
10	a	Explain the principle of DCV	4	CO10	L3
	b	Explain the symbols of hydraulic elements	4	CO10	L3
	c	Explain the types of valve	4	CO10	L3

2. SEE Important Questions

Course:	Mechatronics				Month / Year	Dec /2019	
Crs Code:	15ME753	Sem:	VII	Marks:	80	Time:	180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-
Module	Qno.	Important Question	Marks	CO	Year		
1	1	Define mechatronics. State the major differences between conventional and mechatronics product design approach.	4	CO1			
	2	With a block diagram, briefly explain the generalized measurement system.	4	CO1			
	3	Define the following transducers with examples: (I) Analog transducer. (ii) Digital transducer. (iii) Active transducer. (iv) Passive transducer. (v) Mechanical transducer.	4	CO2			
	4	Explain with a neat diagram, (i) Capacitive proximity sensor. (ii) Principle of Hall effect	4	CO2			
2	1	Discuss basic elements of a closed-loop system.	4	CO3			
	2	Draw the block diagram of a micro controller and mention the functions of each block.	4	CO3			
	3	Explain the flow of instruction sets of 8085A microprocessor.	5	CO4			
	4	List out the functions of ALU	3	CO4			
3	1	Explain the operation of PLC	4	CO5			
	2	Explain the concept of ladder diagram	4	CO5			
	3	Explain the concepts of advanced actuators?	4	CO6			
	4	Explain the concepts of robot controller	4	CO6			
4	1	Explain gear trains mechanism	4	CO7			
	2	Explain ratchet and pawl mechanism	4	CO7			
	3	Explain the concepts of solenoids	4	CO8			
	4	Explain the principle of stepper motor	4	CO8			
5	1	Explain with a neat sketch construction and operation of simple pressure relief valve.	4	CO9			
	2	What are the types of pneumatic actuators? With sketch explain the construction and working principle of single acting cylinder	4	CO9			
	3	Sketch and explain any two types of spool valve	4	CO10			
	4	Sketch and explain solenoid operated DCV	4	CO10			

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA

Module- #	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	B	C	D	E	F	G	H
1	Introduction:Definition, Multidisciplinary Scenario, Evolution of Mechatronics,Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics.	3	L2	L2	- Understand	- Lecture	- Assignment
1	Transducers and sensors:Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors.	7	L2	L2	- Understand -	- Lecture/Tutorial	- Assignment
2	Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.	4	L2	L2	- Understand -	- Lecture	- Assignment
2	Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.	6	L2	L2	- Understand -	- Lecture	- Assignment
3	Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching &selection of a PLC.	5	L2	L2	- Understand -	- Lecture/Tutorial	- Assignment
3	Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.	5	L2	L2	- Understand -	- Lecture	- Assignment
4	Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain		L2 L3	L3	- Understand	- Lecture	- Assignment

	drives, mechanical aspects of motor selection.	5			-Apply		
4	Electrical actuation systems:Electrical systems, Mechanical switches, Solenoids,Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.	5	L2 L3	L3	- Understand -Apply	- Lecture	- Assignment
5	Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Cylinders and rotary actuators.	5	L2 L3	L3	- Understand -Apply	- Lecture/Tutorial	- Assignment
5	DCV & FCV: Principle & construction details, types of sliding spool valve, solenoid operated, Symbols of hydraulic elements, components of hydraulic system, functions of various units of hydraulic system. Design of simple hydraulic circuits for various applications.	5	L2 L3	L3	- Understand -Apply	- Lecture	- Assignment

2. Concepts and Outcomes:

Table 2: Concept to Outcome –

Module - #	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome Student Should be able to ...
A	I	J	K	L	M	N
1	-Multi disciplinary systems	- Disciplinary systems	Inter disciplinary system	Multidisciplinary Scenario	- Understand Multi disciplinary systems	Understand multi disciplinary systems
1	- Working principles	Mechatronics systems	Components	Different principles and working of mechatronics systems.	- Understand different principles and working of mechatronics systems.	Understand working principles of transducer and sensors
2	-Control Systems	- Elements	Working of control systems	Microprocessor and Micro controller	-Understand concepts of control systems	Understand microprocessors and controllers
2	Architecture system.	Different microprocessors	Architecture	Terminologies of microprocessor	Microprocessor architecture and terminology	Understand the architecture of microprocessor
3	Logic functions	Principles and working	Logic Control	Different programmable logic diagrams	Memory devices	Understand the logic controllers
3	Automation	Actuators	Integration	Different actuators	Controlling devices.	Understand concepts of automations
4	Mechanism of mechanical actuators	Mechanical aspects	Mechanisms	Types of Mechanical Actuators	Mechanical Actuators	Understand mechanism of mechanical actuators
4	Mechanism of electrical	Electrical aspects	Components	Types of Electrical Actuators	Electrical actuators	Understand mechanism of electrical actuators

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	actuators					
5	Hydraulic and pneumatic systems	Actuating systems	Actuators	Working of Hydraulic and pneumatic actuators	Hydraulic and pneumatic actuating systems	Understand concepts of hydraulic and pneumatic systems
5	Control Valves	Principle & construction of control Valves	Working principles	Components of hydraulic system	functions of various units of hydraulic system	Understand constructional features