Course Plan

Semester: **4 - Semester**	Year: **2019**
Course Title: **MECHATRONICS**	Course Code: **ES113**
Semester End Examination: **70**	Continuous Internal Evaluation: **30**
Lesson Plan Author: Mr. CH RAJENDRA PRASAD	Last Modified Date: 25-11-2018

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Describe key elements of mechatronic systems
2. Explain the principle and operation of sensors and actuators
3. Apply mechanism of sensors and actuators for an application
4. Examine signal conditioning circuits, speed and power control of motors.
5. Design a mechatronic system.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO-1	PSO-2
1. Describe key elements of mechatronic systems		**3**											**1**	
2. Explain the principle and operation of sensors and actuators	**2**	**3**												
3. Apply mechanism of sensors and actuators for an application		**3**	**2**										**3**	
4. Examine signal conditioning circuits, speed and power control of motors.	**1**			**3**										
5. Design a mechatronic system.			**3**	**2**									**2**	**3**

Course Content

Content	Hrs
Unit - 1	
Chapter No. 1 - INTRODUCTION	12.00 hrs

Introduction to Mechatronics, key elements of mechatronics, Microcontroller fundamentals, introduction to Arduino controller, block diagram, pin map, Procedural and basic embedded programming.	
Unit - 2	
Chapter No. 2 - SENSORS Characteristics of Sensors – static and dynamic, classification – Analog sensors: displacement, force, temperature; Digital sensors: proximity, photo sensors.	24.00 hrs
Unit - 3	
Chapter No. 3 - ACTUATORS Mechanical Drives: gears, belt and chain drives, bearings. Electrical actuation systems: Relays, solid state switches – diodes, transistors, MOSFET, thyristors and triacs; solenoids, fundamentals of dc and ac motors, stepper motor.	15.00 hrs
Unit - 4	
Chapter No. 4 - SIGNAL PROCESSING AND CONDITIONING Rectifiers, filters, regulators, amplifying signals using OP Amps, comparator, fundamentals of ADC and DAC	15.00 hrs
Unit - 5	
Chapter No. 5 - POWER AND SPEED CONTROL Power control of DC and AC motors using SCR, triac, speed control of DC motor using PWM technique, stepper motor control	9.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Clarence W.de Silva,, Sensors and Actuators, CRC Press, 2016
2. W.Bolton, Mechatronics: Electronic Control System in Mechanical and Electrical Engineering, Pearson Education Asia

References

1. D. Patranabi, Sensors and Transducers, PHI Learning pvt Ltd, 2003
2. Muhammad H. Rashid, Power Electronics Hand Book, Academic Press, 2011
3. Ramakanth A. Gayakwad, Operational Amplifiers and Linear Intermitted Circuits, PHI, 1987
4. Mario Bohmer,, Beginning Android ADK with Arduino, A press, 2012

Chapterwise Plan

Course Code and Title: **ES113 / MECHATRONICS**	
Chapter Number and Title: **1 - INTRODUCTION**	Planned Hours: **12.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	**Describe** mechatronic system using key elements	CO1	L2
2	**Identify** real time mechatronics systems	CO1	L3
3	**Explain** Arduino boards (UNO & MEGA) and basic components	CO5	L2
4	**Develop** prototype circuits and connect them to the Arduino	CO3	L3
5	**Design** low level Smart systems applications	CO5	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction to Mechatronics	20-11-2018	
2. Key elements of Mechatronics-1	20-11-2018	
3. Key elements of Mechatronics-2	20-11-2018	
4. Arduino Board Description-1	23-11-2018	
5. Arduino Board Description-2	23-11-2018	
6. Arduino Board Description-3	23-11-2018	
7. Arduino programming-1 LED	27-11-2018	
8. Arduino programming-2 LED	27-11-2018	
9. Arduino programming-3 LED	27-11-2018	
10. Arduino programming-1 LED Switch	30-11-2018	
11. Arduino programming-2 LED Switch	30-11-2018	
12. Arduino programming-3 LED Switch	30-11-2018	

Review Questions

Sl.No. - Questions	TLOs	BL
1. Describe the key elements of mechatronic system	TLO1	L2
2. Differentiate between microprocessors and microcontrollers	TLO1	L2
3. Identify any real-time mechatronics system and Map the components to key elements of mechatronics system	TLO2	L3
4. Draw and explain Pin Map of arduino Mega 2560	TLO3	L2
5. Apply the concept of mechatronics over any one real time application	TLO4	L3
6. Design mechatronics system such that blink an alternate LED with a duration of 3-sec (Turn ON one LED and turn OFF another LED for 3-sec and vice-versa)	TLO5	L3

Course Code and Title: **ES113 / MECHATRONICS**	
Chapter Number and Title: **2 - SENSORS**	Planned Hours: **24.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	**Describe** the characteristics of sensors	CO2	L2,L3
2	**Explain** the working principle and operation of sensors	CO2	L2,L3
3	**List** various real time applications of sensors	CO5	L1
4	**Select** appropriate sensors for suitable applications	CO4	L1,L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
13. Sensor characteristics and classifications, Selection of sensor-1	04-12-2018	
14-15. Sensor characteristics and classifications, Selection of sensor-2	04-12-2018	
16-18. Displacement sensors	07-12-2018	
19-21. Force sensor	07-12-2018	
22-24. Temperature Sensors	11-12-2018	
25-27. Light Sensors	14-12-2018	
28-30. Proximity Sensor	18-12-2018	
34-39. Temperature Sensors	11-12-2018	

Review Questions

Sl.No. - Questions	TLOs	BL
1. Explain the dynamic characteristics of sensors.	TLO1	L2
2. Develop a mechatronic system to monitor temperature in our laboratory room continuously. Indicate the result by glowing red colour LED, if temperature is beyond the threshold level. Otherwise glow green LED.	TLO2	L1
3. Find the room temperature with LM35 using arduino program	TLO3	L1
4. Consider a seminar hall with a seating capacity of 100, suggest a sensor and develop a system to display the number of vacant seats.	TLO2	L3
5. What is the selection criteria for a selection of sensors	TLO4	L5

6. Analyze force mesearement using Strain gauge load cell	TLO2	L4

Course Code and Title: **ES113 / MECHATRONICS**	
Chapter Number and Title: **3 - ACTUATORS**	Planned Hours: **15.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	**Explain** the basic operation of mechanical actuators	CO2	L2
2	**Describe** switching mechanism of solid state devices	CO2	L2
3	**Apply** switching mechanism to control electronics/mechanical devices	CO3	L3
4	**List** various real time applications of actuators	CO3	L1,L3
5	**Select** appropriate Actuators for suitable applications	CO5	L3,L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
40-42. Actuators	21-12-2018	
43-45. Design a power supply unit (5V, 12V)	04-01-2019	
46-48. Thyristor (SCR) TRIAC(Theory & animation)	04-01-2019	
49-51. Motors	08-01-2019	
52-54. Mechanical Actuators	25-01-2019	
55-57. DC motors	08-01-2019	
58-60. Stepper motor	22-01-2019	
61-63. Relays	28-12-2018	

Review Questions

Sl.No. - Questions	TLOs	BL
1. Write short notes on gears and gear trains.	TLO1	L2
2. Explain switching characteristics of SCR	TLO2	L2
3. Develop a system to control the bulb based on the intensity of the sun light.	TLO5	L3
4. Apply transistor switching action to any one application	TLO3	L3

5. Choose the driven gear to design a robot with a gear ratio of 6, using a 40 teeth driving gear.	TLO4	L3

Course Code and Title: **ES113 / MECHATRONICS**	
Chapter Number and Title: **4 - SIGNAL PROCESSING AND CONDITIONING**	Planned Hours: **15.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	**Describe** different signal processing circuits	CO4	L2
2	**Analyze** various applications of operational amplifier	CO4	L3
3	**Design** a power supply unit	CO4	L3
4	**Explain** the operation of ADC and DAC	CO4	L2
5	**Select** appropriate signal conditioning circuit for suitable applications	CO5	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
64-66. Operational Amplifiers	01-02-2019	
67-69. Digital to Analog converters	08-02-2019	
70-72. Analog to digital converters	15-02-2019	

Review Questions

Sl.No. - Questions	TLOs	BL
1. What is the necessity of signal conditioning circuit in mechatronic system	TLO1	L2
2. Develop the summing amplifier circuit and show how it adds two signals.	TLO2	L4
3. Construct a power supply unit to generate 12V DC	TLO3	L6
4. Explain the operation of binary weighted DAC with bit position as 010 and calculate its resolution	TLO4	L3
5. Design a signal conditioning circuit to provide 5V signal, if input sensor 1.5V	TLO5	L5

Course Code and Title: **ES113 / MECHATRONICS**	
Chapter Number and Title: **5 - POWER AND SPEED CONTROL**	Planned Hours: **9.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	**Recall** the concepts of Thyristors	CO4	L1
2	**Describe** power and speed control of motors	CO4	L2,L3
3	**Analyze** power and speed control of motors	CO4	L4
4	**Apply** PWM technique to control the speed of DC Motor	CO4	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
73-74. Speed control of motors	19-02-2019	

Review Questions

Sl.No. - Questions	TLOs	BL
1. Control speed of DC motor using PWM technique for a given duty cycle	TLO4	L3
2. Describe speed control of DC motor using SCR	TLO2	L2
3. List speed control techniques of motors	TLO1	L1
4. Analyze power control of ac motor using TRIAC	TLO3	L4
5. List control techniques of motors	TLO1	L1
6. Analyze power control performances of motors using SCR and TRIAC	TLO3	L4
7. Explain methods to change the step angle of a stepper motor	TLO2	L2
8. Select a suitable driver IC to drive a motor such that it can rotate in clockwise for 10sec and counter clockwise direction for 20sec	TLO2	L3