15MH203	Electrical Machines and Actuators			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	15EE101						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Core	Electrical Engineering				
Course designed by	Department of Mechatronics Engineering						
Approval	32nd Academic Council Meeting held on 23.07.2016.						

Purpose	To impart knowledge of electrical machines and actuators for a wide range of engineering applications.							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	Understand the specific purpose of electrical machines.	a	e					
2.	Select the proper machine and parameters to attain the proper operation.	a	e					
3.	Gain knowledge in various electrical actuators.	a						
4.	Learn the working of various electro static and electro dynamic actuators.	a						

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
	Unit I: DC Machines	**9**			
1.	DC machines: Construction, principle.	1	C	1	1
2.	Types of DC machines based on construction.	1	C	2	1
3.	Back Emf, voltage equations, torque equation.	1	D	2	1
4.	Characteristics of DC motors.	2	C	1,2	1
5.	Necessity of a starter, types of starters: 3 point.	1	C	1,2	1
6.	Types of starters: 4 point.	1	C	1,2	1
7.	Braking methods: Dynamic and plugging.	1	C	1	1
8.	Regenerative braking.	1	C	1	1
	Unit II: Transformers and Induction Machines	**9**			
9.	Transformer: Construction, principle.	1	C	1	1
10.	Emf equation, voltage regulation.	1	D	1,2	1
11.	Introduction to 3-phase system.	1	C	1	1
12.	Three phase induction motor construction.	1	C	1	1
13.	Production of RMF.	1	C	1	1
14.	Torque-slip characteristics, torque equation.	1	C	1,2	1
15.	Linear Induction Motors: Construction, principle.	1	C	1	11
16.	Principle and operation of single phase capacitor start capacitor run induction motor.	1	C	1	1
17.	Principle and operation of single phase capacitor start induction run induction motor.	1	C	1	1
	Unit III: Synchronous and Special Machines	**9**			
18.	Synchronous motor: Construction, principle of operation.	1	C	1	3
19.	PMDC motors: Construction, principle of operation.	1	C	1	11
20.	Stepper motors: Construction, principle of operation.	1	C	1	11
21.	Permanent magnet and variable reluctance type: Construction, principle of operation.	1	C	1	11
22.	Hybrid stepper motors: Construction, principle of operation.	1	C	1	11
23.	BLDC motors: Construction, principle of operation.	1	C	1	11
24.	Servo motors: Types of servo motors, construction.	1	C	1,2	12
25.	Servo mechanism: Principle of operation.	1	C	1	12
26.	Construction of AC and DC servo motors.	1	C	1,2	12
	Unit IV : Switching Circuits for Actuators	**8**			
27.	Introduction: Types of actuators.	1	C	3	10
28.	Electrical actuators and their advantages over other types of actuators.	1	C	3	10
29.	Solenoid, relays: Construction, principle and operation.	1	C	3	10
30.	Applications of electrical actuators.	1	C	3,4	10
31.	Fuses, circuit breakers.	1	C	3	10

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
32.	Design of actuation circuits using diode, transistor MOSFET.	2	C	3	10
33.	Design of actuation circuits using TRIAC and thyristor.	1	C	3	10
	Unit V:Applications of Actuators	**6**			
34.	Piezoelectric actuator: Construction, principle of operation	1	C	3,4	2
35.	Electro active polymer switch: Construction, principle of operation.	1	C	3,4	6
36.	MEMS actuators: Construction, principle of operation.	1	C	3,4	8
37.	Digital micro mirror device and comb drive: Construction, principle of operation.	1	C	3,4	7
38.	Micro pump and fuel injectors: Construction, principle of operation.	1	C	3,4	8,4
39.	Robotic grippers: Construction, principle of operation.	1	C	3,4	5
	Assessment	**4**			
40.	Cycle test – I	1			
41.	Cycle test – II	2			
42.	Surprise test / Assignment and Quiz	1			
	Total contact hours	**45**			

Learning Resources	
SI.No.	**Text Books**
1.	Theraja B.L and Theraja A.K , "*A Textbook of Electrical Technology*", Volume 2: AC and DC machines, 23rd edition, S.Chand Publications, 2006.
2.	John.R Brauer, "*Magnetic Actuators and Sensors*", 2nd edition, Willey-IEEE Press.
	Reference Books/Other Reading Materials
3.	Stephen Chapman, "*Electric Machinery Fundamentals*", McGraw-Hill Series in Electrical and Computer Engineering 4th edition.
4.	Ronald K Jurgen, "*Actuators: Automotive Electronics Series*", SAE, 1999.
5.	Gareth J Monkman, Stefen Hesse, Ralf Steinmann, Henric Schunk, "*Robot Grippers*", Wiley-VCH, 2006.
6.	Kim, Kwang J., and Satoshi Tadokoro, "*Electroactive Polymers for Robotic Applications*", *Artificial Muscles and Sensors (291 p.),* 2007.
7.	Chen, Chihchung, and Chengkuo Lee, "*Design and Modelling for Comb Drive Actuator With Enlarged Static Displacement*,"*Sensors and Actuators A: Physical* 115 (2), pages: 530-539, 2004.
8.	Tai-Ran-Hsu, "*MEMS and Microsystems: Design and Manufacture*", Mc Graw Hill, 2002.
9.	Muhammad H. Rashid, "*Power Electronics: Circuits, Devices and Applications*", Pearson Publications, 4th edition, 2014.
10.	Hartmut Janocha, "*Actuators: Basics and Applications*", Springer science and business media, 2004.
11.	K.Venkataratnam, "*Special Electric Machines*", University Press, 2009.
12.	Riazollah Firoozian, "*Servo Motors and Industrial Control Theory*", Springer 2nd edition, 2009.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
					End semester examination weightage:		**50%**