Paper Code: ARI 209	L	T/P	Credits
Subject: Mechatronic Systems and Applications	4	-	4

Marking Scheme

Teachers Continuous Evaluation: As per university examination norms from time to time.

End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per University Norms

➢ There should be 9 questions in the end term examination question paper
➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 15 marks.
➢ Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 15 marks.
➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Outcomes [Bloom's Knowledge Level (KL)]:

CO1:	Ability of students to explain the basic fundamentals of mechatronics. **[K1, K2]**
CO2:	Ability of students to select appropriate sensors and actuators, and apply signal conditioning to monitor and control of a mechatronics system. **[K1, K2, K3, K4]**
CO3:	Ability of students to understand about the basics of microprocessor, microcontroller and PLCs, and develop their programming concepts for mechatronics system development. **[K1, K2, K4, K6]**
CO4:	Ability of students to apply the system modelling concepts to model and analyze the mechatronics systems. **[K3, K4]**

Course Outcomes (CO)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	2	3	2	-	-	-	3	1	2	3
CO2	3	3	3	3	2	-	-	-	3	1	2	3
CO3	3	3	3	3	3	-	-	-	3	1	3	3
CO4	3	3	3	3	2	-	-	-	3	1	3	3

Course Content	No of lectures
Unit I **Introduction:** Definition of mechatronics, measurement system, control systems, microprocessor-based controllers, mechatronics approach. **Sensors and Transducers:** Introduction, Performance terminology, static and dynamic characteristics of transducers, selection of sensors. Sensor for measurement of displacement, position, motion, force, torque, strain gauge, temperature, pressure and flow. Optical encoder, tactile and proximity, ultrasonic sensor & transducers, opto-electrical sensor, gyroscope. Smart sensors.	[10]
Unit II **Actuators:** Definition, example, types, selection. Mechanical Actuation System: Cams, Gear trains, Ratchet and Pawl, Belt and chain drives, Bearings. Hydraulic and Pneumatic Actuation System: Pneumatic actuator. Electro-pneumatic actuator. Hydraulic actuator, process control valves. Electrical actuating systems: solid-state switches, solenoids, voice coil; electric motors; DC motors,	[10]

AC motors, single phase motor; 3-phase motor; induction motor; synchronous motor; stepper motors. Piezoelectric actuator: characterization, operation, and fabrication; shape memory alloys. **Signal Conditioning:** Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.	
Unit III **Microprocessors & Microcontroller:** Introduction, Microprocessor building blocks, combinational and sequential logic elements, memory, timing and instruction execution fundamentals with example of primitive microprocessor. Embedded System: Introduction and Applications. Microcontrollers for mechatronics: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, Microcontroller programming interfaces. **Programmable logic controllers:** Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus Microcontrollers, Programming on PLC.	[12]
Unit IV **System Models:** Mathematical models, Mechanical, Electrical, Hydraulic and Thermal Systems, Modelling of dynamic systems. Design of Mechatronics systems: Stages in designing mechatronics system, Traditional and Mechatronic design. Dynamic response of systems, transfer function and frequency response, closed loop controllers. **Mechatronics system applications**: Boat Auto pilot, Pick and place robots, high speed tilting train, automatic car park system, coin counter, engine management system, automated guided vehicle, autonomous mobile system, antilock brake system control, Auto-Focus Camera, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader.	[8]

Text Books:
    [T1] W.Bolton, (2003) *Mechatronics*, Pearson education, second edition, fifth Indian Reprint.
    [T2] "Introduction to Mechatronics and Measurement Systems" by David G Alciatore and Michel BiHistand.
    [T3] "Principles, Concepts and Applications - Mechatronics" by Nitaigour and Premchand Mahilik
    [T4] Smaili, A., & Mrad, F. (2008). *Mechatronics: Integrated technologies for intelligent machines*. Oxford University Press.	

Reference Books:
    [R1] R.K Rajput, (2007) *A textbook of mechatronics*, S. Chand & Co.
    [R2] D. A. Bradley, Dawson D., Buru N.C. and. Loader A.J, (1993) *Mechatronics*, Chapman and Hall.
    [R3] Necsulescu, D. S. (2002). *Mechatronics*. Pearson College Division.
    [R4] Kamm, L. J. (1995). *Understanding electro-mechanical engineering: an introduction to mechatronics* (Vol. 3). John Wiley & Sons.
    [R5] Nitaigour Premchand Mahadik, (2003) *Mechatronics*, Tata McGraw-Hill publishing Company Ltd, 2003.	