University School of Automation and Robotics
GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
East Delhi Campus, Surajmal Vihar
Delhi - 110092

Paper Code: ARA 204

Subject: Mechatronic Systems and Applications	**L**	**T/P**	**Credits**
	4	-	4

Marking Scheme

1. Teachers Continuous Evaluation: 25 Marks
2. End Term Theory Examination: 75 Marks

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks : 75**

1. There should be 9 questions in the end term examination question paper
2. 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.
3. 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.
4. 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.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes:

CO1:	Ability of students to identify, analyze and solve engineering problems related to mechatronics engineering.
CO2:	Ability of students to utilize the various sensors used to measure various physical parameters and implement knowledge of signal conditioning, data acquisition and communication systems used in mechatronics system development
CO3:	Ability of students to utilize understanding of basic functions, structure, concepts, programming and applications of embedded systems
CO4:	Ability of students to practically apply gained theoretical knowledge to design, analyze and implement embedded systems for application in industry automation.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit I

Introduction: Introduction to Mechatronics System, Elements of mechatronics system, mechatronics in manufacturing, product and design, Measurement Systems, Control System, comparison between traditional and mechatronics approach. **[12]**

Sensors and Transducers: Introduction, Performance terminology, static and dynamic characteristics of transducers, Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT. Strain Measurement: Theory of Strain Gauges, Bridge circuit, Strain gauge based load cells and torque sensors, Velocity and Motion: Electromagnetic tachometer, photoelectric tachometer, variable reluctance tachometer, Digital Encoders. Vibration and acceleration: Eddy current type, piezoelectric type; Accelerometer: Principle of working, practical accelerometers, strain gauge based and piezoelectric accelerometers. Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors. Flow Measurement: Bernoulli flowmeter, Ultrasonic flowmeter, Magnetic flow meter, Rotameter. Miscellaneous Sensors:

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Leak detector, Flame detector, Smoke detector, pH sensors, Conductivity sensors, Humidity sensors, Potentiometric Biosensors and Proximity sensors. Selection of sensors

Unit II **[10]**

Mechanical Actuation System: Cams, Gear trains, Ratchet and Pawl, Belt and chain drives, Bearings.

Hydraulic and Pneumatic Actuation System: Introduction to Hydraulic and Pneumatic Systems, Directional Control valves, Flow control valves.

Electrical Actuation System: Electrical systems, Solid State Switches, Solenoids, D.C. motors, A.C. motors, Stepper motors.

Unit III **[12]**

Microprocessors: Microprocessor systems, Microcontrollers, applications.

Programmable logic controllers: Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays And Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC.

Unit IV **[8]**

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.

Case studies of Mechatronics system: Mechatronic approach to design, 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

Text Books:

1. W.Bolton, (2003) *Mechatronics*, Pearson education, second edition, fifth Indian Reprint.
2. Smaili, A., & Mrad, F. (2008). *Mechatronics: Integrated technologies for intelligent machines*. Oxford University Press.
3. Alciatore, D. G. (2007). *Introduction to mechatronics and measurement systems*. Tata McGraw-Hill Education.

Reference Books:

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

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