SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

VII SEMESTER

1909703-MECHATRONICS AND AUTOMATION

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UNIT- I : INTRODUCTION

Introduction to Mechatronics – Concepts of Mechatronics approach – Need for Mechatronics- Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors – Actuators – Classification – Stepper motor – Servo motor

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Define the term 'Mechatronics'.	BT1	Remember
2.	Interpret the term 'Control System'.	BT1	Remember
3.	Illustrate about the mechatronics approach in a microprocessor controlled washing machine.	BT2	Understand
4.	Define Open loop system.	BT1	Remember
5.	Summarize the functions of Sequential Controllers.	BT1	Remember
6.	Illustrate about the block diagram of measurement system.	BT2	Understand
7.	Summarize the Classification of mechatronics.	BT1	Remember
8.	Define settling time.	BT1	Remember
9.	Generalize about impedance of an element.	BT2	Understand
10.	Enumerate the function of comparison element.	BT1	Remember
11.	Describe the uses of bi-metallic strip.	BT1	Remember

12.	Invent the applications of eddy current.	BT2	Understand
13.	Examine the principle of photo conductivity.	BT1	Remember
14.	What is a Sensor?	BT2	Understand
15.	Categorize any two applications of hall effect sensor.	BT1	Remember
16.	Discuss the principle of RTD.	BT1	Remember
17.	Summarize the types of potentiometer.	BT1	Remember
18.	Discover about hall effect sensor.	BT2	Understand
19.	Point out the types of sensors.	BT1	Remember
20.	Formulate the function of intelligent mechatronics systems.	BT1	Remember
21.	Define actuation.	BT2	Understand
22.	What are actuators?	BT1	Remember
23.	Classify actuators.	BT1	Remember
24.	Explain how stepper motor works.	BT2	Understand
25.	Discuss how Servo motor works.	BT1	Remember

	PART-B (13 Marks)			
Q.No	Questions	Marks	BT Level	Competence
1	(i) Identify the emerging areas of Mechatronics. (6)	7	BT3	Apply
	(ii) Discuss the working principle and application of a potentiometer sensor. (7)	6	BT4	Analyze
2	(i) Analyze the concept of control system. (6)	7	BT3	Apply

	(ii)Show the difference between open loop and closed loop control system. **(7)**	6	BT4	Analyze
3	Summarize about the classification of mechatronics system. Explain it.	13	BT4	Analyze
4	Describe the concept of shaft speed control in mechatronics approach with neat block diagram.	13	BT4	Analyze
5	Illustrate about static characteristics of sensors briefly.	13	BT4	Analyze
6	Summarize: (i)Dynamic characteristics of sensors. (ii)Two types of light sensors.	6 7	BT3 BT4	Apply Analyze
7	Generalize the concept of capacitance sensor with a neat sketch.	13	BT4	Analyze
8	(i) Discuss about eddy current sensor with neat diagram. Collect its uses also. (ii)Illustrate about static characteristics of sensors briefly.	6 7	BT3 BT4	Apply Analyze
9	Describe the working principle of LVDT with neat sketch.	13	BT4	Analyze
10	Illustrate the concept of strain gauge. Classify its types.	6	BT4	Analyze
	Examine the following: (i) Temperature sensor (ii) Hall effect sensor	4 3	BT3 BT4	Apply Analyze
11	Compare and contrast the control system for the domestic central heating system involving a bimetallic thermostat and that involving a microprocessor.	13	BT4	Analyze
12	Describe the working principle of LVDT with neat sketch.	13	BT3	Apply
13	(i) Summarize about automatic Control of water level.	6	BT3	Apply

	(ii) Collect the important elements of measurement system.	7	BT4	Analyze
14	Predict the factors to be considered for the selection of sensor. Explain in detail with any two examples.	13	BT3	Apply
15	Define in detail with neat sketches actuation.	13	BT4	Analyze
16	Narrate in detail with suitable sketches what are actuators.	13	BT4	Analyze
17	Classify actuators in detail with suitable sketches.	13	BT3	Apply
18	With neat sketches explain in detail how stepper motor works.	13	BT3	Apply

PART-C (15 Marks)				
S.No	**Questions**	**Marks**	**BT Level**	**Competence**
1	Explain the working of closed loop control employed in controlling the shaft speed with a neat block diagram.	15	BT6	Create
2	Discuss and appraise how displacement is sensed by LVTD. With neat sketch show how it can be made phase sensitive.	15	BT5	Evaluate
3	Categorize any three sensors used in temperature measurement and also explain the principle of any three sensors used for measuringdisplacement.	15	BT6	Create
4	Formulate thermistor and RTD with its applications	15	BT5	Evaluate
5	A case study of application of actuators may be presented with sketches	15	BT6	Create

UNIT- II : SYSTEM MODELS AND CONTROLLERS

Systems – Classification - Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Translational Systems, Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	What is damper?	BT-2	Understanding
2.	Define the term electromechanical systems	BT-2	Understanding
3.	What is the function of hydraulic power system?	BT-2	Understanding
4.	What is a block diagram?	BT-2	Understanding
5.	How do you define pneumatic system?	BT-2	Understanding
6.	Define transfer function.	BT-1	Remembering
7.	State the purpose of control system.	BT-2	Understanding
8.	What is meant by steady state error?	BT-1	Remembering
9.	What does marginally stable invariant system mean?	BT-1	Remembering
10.	Define proportional band.	BT-2	Understanding
11.	Mention the advantages of integral control.	BT-2	Understanding
12.	Why do we need to take care while using derivative control?	BT-2	Understanding

13.	How can adaptive controllers be defined?	BT-2	Understanding
14.	What does truth table refer	BT-2	Understanding
15.	Define encoding and decoding processes.	BT-2	Understanding
16.	Define Systems.	BT-2	Understanding
17.	Classify systems.	BT-1	Remembering
18.	What are Building blocks of Mechanical Systems?	BT-1	Remembering
19.	What are Building blocks of Electrical Systems?	BT-2	Understanding
20.	What are Building blocks of Fluid Systems?	BT-1	Remembering
21.	What are Building blocks of Thermal Systems?	BT-2	Understanding
22.	What are Building blocks of Rotational Systems?	BT-1	Remembering
23.	Define Control Mode	BT-1	Remembering
24.	Expand PID Controllers	BT-1	Remembering
25.	What are Digital Controllers?	BT-1	Remembering

	PART-B (13 Marks)			
Q.No	Questions	Marks	BT Level	Competence
1	Derive a mathematical equation for a machine mounted on the ground to study the effects of ground disturbances on the machine bed displacement.	13	BT4	Analyze
2	Compare the control system performance for a system with proportional control and s system with integral control.	13	BT3	Apply
3	Derive a mathematical differential equation for governing a system of electric motor.	13	BT3	Apply
4	Explain the characteristics of PID controller.	13	BT4	Analyze

5	A hot object with capacitance C and temperature T ,cools in a large room at temperature Ta.If the thermal system has a resistance R,derive an equation describing how the temperature of the hot object changes with time and give an electrical analogue of the system.	13	BT4	Analyze
6	Prepare a model for a stepped shaft used to rotate a mass and derive an equation relating the input torque and the angular rotation. Neglect the damping effect.	13	BT4	Analyze
7	Describe and compare the characteristics of proportional controller and proportional plus integral controller.	13	BT3	Apply
8	Describe adaptive control and digital logic controller.	13	BT3	Apply
9	Define Systems with neat sketches.	13	BT3	Apply
10	Classify the different systems.	6	BT3	Apply
	What are Building blocks of Mechanical Systems, explain in detail.	7	BT4	Analyze
11	Explain in detail what are Building blocks of Electrical Systems	13	BT4	Analyze
12	Draw neat sketches for Building blocks of Fluid Systems.	13	BT3	Apply
13	Describe with neat sketches for Building blocks of Thermal Systems.	13	BT3	Apply
14	Derive Building blocks of Rotational Systems.	13	BT3	Apply
15	Draw neat sketches for Control Mode	13	BT3	Apply
16	Describe with neat sketches for PID Controllers.	13	BT3	Apply
17	Draw neat sketches for Digital Controllers	13	BT4	Analyze
18	Describe and compare the characteristics of proportional controller and proportional plus integral controller.	13	BT4	Analyze

PART-C (15 Marks)				
S.No	Questions	Marks	BT Level	Competence
1	Present a case study on Systems and Classification.	15	BT6	Create
2	Eloborate a case study on Building blocks of Mechanical, Electrical, Fluid and Thermal Systems.	15	BT5	Evaluate
3	Narrate a case study on Rotational – Translational Systems, Continuous and discrete process Controllers	15	BT6	Create
4	Present a case study on Control Mode – Two – Step mode – Proportional Mode	15	BT5	Evaluate
5	Discuss a case study on Derivative Mode – Integral Mode	15	BT6	Create

UNIT - III : MICROPROCESSOR AND MICROCONTROLLER

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set of 8085 – Concepts of 8051 microcontroller – Block diagram –Architecture of 8255 - Stepper MotorControl – Traffic Control interface, Introduction to Arduino processor.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Express few features of Intel 8085 microprocessor.	BT-1	Remembering
2.	Name any four 8-bit microprocessors.	BT-1	Remembering
3.	Classify the types of addressing modes of 8085.	BT-2	Understanding
4.	Point out the flags available in 8085 microprocessor.	BT-2	Understanding
5.	Summarize the 16 bit registers in 8085 microprocessor.	BT-2	Understanding
6.	Define 'CPU'.	BT-1	Remembering
7.	Generalize various machine cycles in 8085 microprocessor.	BT-2	Understanding
8.	Compare fetch and execute cycle.	BT-1	Remembering
9.	Define the term 'ALU'.	BT-1	Remembering
10.	Describe four control signals commonly used in 8085 microprocessor.	BT-2	Understanding
11.	Differentiate microprocessor and microcontroller.	BT-2	Understanding
12.	Quote about Microcontroller. Give examples.	BT-2	Understanding
13.	Express the features of 8051 microcontroller.	BT-2	Understanding
14.	Name the special function registers in 8051 microcontroller.	BT-2	Understanding

15.	Point out the interrupts available in 8051 microcontroller.	BT-2	Understanding
16.	Generalize different operating modes for serial communication of 8051 microcontroller.	BT-2	Understanding
17.	Quote the Modes of timers in 8051 microcontroller.	BT-1	Remembering
18.	Recommend the memory size of 8051 microcontroller.	BT-1	Remembering
19.	Classify different ports of 8051.	BT-2	Understanding
20.	Give the SFRS of 8051.	BT-1	Remembering
21.	List the function of Read/Write control logic in 8255 PPI.	BT-2	Understanding
22.	Describe about different ports of 8255 PPI.	BT-2	Understanding
23.	Illustrate the classification of ports in 8255 PPI.	BT-2	Understanding
24.	Tabulate the selection points in operating mode in 8255 PPI.	BT-2	Understanding
25.	List the real time applications of Arduino processor.	BT-2	Understanding

PART-B (13 Marks)				
Q.No	Questions	Marks	BT Level	Compete nce
1	Draw the architecture diagram of 8085 microprocessor and explain the functions of individual elements with neat diagram.	13	BT3	Apply
2	(i)What are the functions of address, data and control buses? **(6)** (i) Discuss the features of 8085 microprocessor.	7 6	BT3 BT4	Apply Analyze
3	Illustrate about the pin configuration of 8085 microprocessor with a suitable sketch.	13	BT4	Analyze
4	Discover the different types of addressing modes of 8085 microprocessor.Discuss it briefly.	13	BT4	Analyze
5	Appraise various types of instruction set in 8085 microprocessor.	13	BT4	Analyze

6	(i)Point out the flags of program status word register of 8085 microprocessor.
	    (6)
	(ii)Explain the register set of 8085 microprocessors.
	    (7)
		7
		
		6
			BT3
			
			BT4
				Apply
				
				Analyze

7	Formulate the timing diagram of memory read and memory write cycle in 8085 microprocessor.	13	BT3	Apply
8	Describe the architecture 8051 microcontroller. Draw its diagram.	6	BT3	Apply
	Infer about pin diagram of 8051 microcontroller and explain its port Structure.	7	BT3	Apply
9	Express about Timers in 8051 with suitable examples.	13	BT4	Analyze
10	Describe about TMOD register format, operating modes of timer in 8051 microcontroller.	13	BT4	Analyze
11	Point out the features of 8051 microcontroller.	13	BT4	Analyze
12	Summarize the instruction set of 8051 microcontroller.	13	BT4	Analyze
13	Write an assembly language program using 8051microcontroller to control a stepper motor.	13	BT3	Apply
14	(i) Identify the features of 8255 PPI. (ii) (ii) Describe the needs for interfacing.	6 7	BT3 BT4	Apply Analyze
15	Summarize about the architecture of 8255 PPI.	13	BT3	Apply
16	Illustrate the functional description of various pins in 8255 PPI with neat sketch.	13	BT4	Analyze
17	Evaluate the various operating features Arduino processor.	13	BT4	Analyze
18	Formulate the timing diagram of memory read and memory write cycle in 8085 microprocessor.	13	BT3	Apply

	PART-C (15 Marks)			
S.No	Questions	Marks	BT Level	Competence
1	Draw the timing diagram of the instruction MOV A, B and explain the Process.	15	BT6	Create
2	Formulate all the Data transfer, Arithmetic and Logical instructions.	15	BT5	Evaluate
3	Summarize on C.condition and R.condition instruction perform CALL and Return operations.	15	BT6	Create
4	Explain Stack I/O and Machine control instruction.	15	BT5	Evaluate
5	Formulate execution of memory-related Data Transfer Instructions.	15	BT6	Create

UNIT- IV: PROGRAMMABLE LOGIC CONTROLLERS

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Selection of a PLC.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	Why is PLC preferred over PC in factories?	BT-2	Understanding
2.	Define evolution of PLC.	BT-2	Understanding
3.	Explain the features of PLC.	BT-2	Understanding
4.	Recommend the advantages of PLC over traditional control systems.	BT-2	Understanding
5.	Describe the types of PLCs.	BT-2	Understanding
6.	Generalize the rules to write a ladder logic diagram.	BT-1	Remembering
7.	Name the types of logic gates.	BT-2	Understanding
8.	Examine about the ladder diagram for latching. Why it is used in PLC.	BT-1	Remembering
9.	Describe sinking and sourcing.	BT-1	Remembering
10.	Compare ON delay timer and OFF delay timer.	BT-2	Understanding
11.	Enumerate modular I/O PLC.	BT-1	Remembering
12.	Prepare any two applications of Counters.	BT-1	Remembering
13.	Define internal relay in PLC.	BT-2	Understanding
14.	Express the ladder diagram for Cascaded timers.	BT-1	Remembering

15.	At what conditions master control is used?	BT-2	Understanding
16.	Discuss working principle of the PLC memory.	BT-1	Remembering
17.	Support the data handling operations in PLC.	BT-1	Remembering
18.	Analyze the factors to be considered for selection of PLC.	BT-1	Remembering
19.	Define MCR instruction.	BT-1	Remembering
20.	How will you process the input and output of PLC?	BT-1	Remembering
21.	Define Timers, Internal relays and counters	BT-1	Remembering
22.	What are Shift Registers?	BT-1	Remembering
23.	Differentiate Master and Jump Controls.	BT-1	Remembering
24.	Express Data Handling	BT-1	Remembering
25.	Points in Selection of a PLC	BT-1	Remembering

	PART-B (13 Marks)			
Q.No	Questions	Marks	BT Level	Competence
1	Draw the architecture of PLC with neat sketch and explain the functions of its elements.	13	BT3	Apply
2	Examine about the input and output processing of PLC.	13	BT3	Apply
3	Summarize about ladder diagram for various logic functions.	13	BT4	Analyze
4	How is an internal relay used to control multiple inputs and outputs?	13	BT4	Analyze

5	Explain the following with suitable examples:
	
	(i) Up Counter
	    (7)
	(ii) Down Counter
	    (6)
		7
		
		6
			BT4
			
			BT-3
				Analyze
				
				Apply

6	Discover the function of sequencing. Draw ladder diagram for A+B+A-B-.	13	BT3	Apply

7	Summarize the mnemonics codes for various logic gates.	13	BT3	Apply
8	With the application of an internal relay draw the ladder diagram for A+B+B-A- cylinder sequence. Apply the concept of latching to control the motor and also draw the ladder diagram.	13	BT3	Apply
9	Analyze the function of shift register with suitable timing diagram.	13	BT4	Analyze
10	(i) Discuss about the temperature control system using PLC.	6	BT4	Analyze
	(ii) Describe various data handling operations.	7	BT4	Analyze
11	Explain the following with ladder diagrams: (i) ON delay timer (7) (ii) OFF delay timer (6)	7 6	BT4 BT-3	Analyze Apply
12	Point out the factors to be considered for selecting a PLC with one example.	13	BT3	Apply
13	Elaborate in detail the Timers, Internal relays and counters	13	BT3	Apply
14	Discuss in detail the Shift Registers.	13	BT3	Apply
15	With neat sketches differentiate Master and Jump Controls.	13	BT4	Analyze
16	Discuss about the Data Handling with examples.	13	BT4	Analyze
17	Draw the architecture of PLC with neat sketch and explain the functions of its elements.	13	BT3	Apply
18	Examine about the input and output processing of PLC.	13	BT3	Apply

	PART-C (15 Marks)

S.No	Questions	Marks	BT Level	Competence
1	Draw the ladder rungs to represent the following: (i) Two switches are normally open and both have to be closed for a motor to operate. **(8)** (ii) Either of two, normally open, switches have to be closed for a coil to be energized and operate an actuator.	8 7	BT6 BT5	Create Evaluate
2	Explain the architecture of a PLC and explain its elements.	15	BT5	Evaluate
3	Develop a system, using a PLC, which can be used to control the movement of a piston in a cylinder using a 4/2 solenoid-operated pilot valve. The piston is to move in one direction when a proximity sensor at one end of the stroke closes contacts and in the other direction when a proximity sensor at the other end of the stroke indicates its arrival there.	15	BT6	Create
4	Generalize a circuit that could be used with a domestic washing machineto switch on a pump to pump water for 100s into the machine, then switch off and switches on a heater for 50s to heat the water. The heater is then switched off and another pump to empty the water from the machine for 100s.	15	BT5	Evaluate
5	Present a case study of data handling in detail.	15	BT6	Create

UNIT- V : MECHATRONIC SYSTEM DESIGN

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Case studies of Mechatronics systems- Pick and place Robot- Engine Management system- Automatic car parkbarrier.

PART-A (2 Marks)

Q.No.	Questions	BT Level	Competence
1.	List the types of Actuators.	BT-1	Remembering
2.	How a servo motor is controlled?	BT-1	Remembering
3.	Summarize the drawbacks of traditional design approach.	BT-1	Remembering
4.	Explain the significant difference between traditional and mechatronicssystem.	BT-2	Understanding
5.	Generalize the mechatronics approach is useful in temperature control ofRefrigerating system.	BT-2	Understanding
6.	Classify the important stages of design process.	BT-1	Remembering
7.	Predict the functions of engine management system.	BT-2	Understanding
8.	List the sensors and actuators used in pick and place robot systems.	BT-1	Remembering
9.	Evaluate how does a car barrier work.	BT-1	Remembering
10.	Point out the function of decoder.	BT-2	Understanding
11.	Illustrate various movements of robots.	BT-2	Understanding
12.	Describe an engine management system.	BT-2	Understanding
13.	Predict the uses of stepper motors.	BT-2	Understanding
14.	Prepare any four statements about the problem definition.	BT-2	Understanding
15.	Summarize two barriers used in automatic car parking system and state its uses.	BT-2	Understanding
16.	List out various sensors used in engine management system.	BT-2	Understanding
17.	Describe how to achieve a control in a stepper motor.	BT-1	Remembering

18.	Compare unipolar and bipolar control of stepper motor.	BT-1	Remembering
19.	Differentiate half stepping and full stepping.	BT-2	Understanding
20.	Generalize the applications of AC and DC servomotor.	BT-1	Remembering
21.	What is a Pick and place Robot	BT-1	Remembering
22.	Define Engine Management system.	BT-1	Remembering
23.	Point out the need of an Automatic car park barrier.	BT-1	Remembering
24.	Point out 2 controls in Engine Management system.	BT-1	Remembering
25.	Point out 2 applications of an Automatic car park barrier.	BT-1	Remembering

PART-B (13 Marks)				
Q.No	Questions	Marks	BT Level	Competence
1	(i) Analyze the stages of mechatronics design process. (6) (ii) Differentiate traditional and mechatronics systems. (7)	7 6	BT4 BT-3	Analyze Apply
2	Illustrate the construction and working principle of stepper motor.	13	BT-2	Understanding
3	List the types of stepper motor. Explain in detail.	13	BT-3	Applying
4	Explain the specifications of stepper motor. Explain it briefly.	13	BT-2	Understanding
5	(i) Illustrate the advantages and disadvantages of stepper motor. (7) (ii) Discover the construction and working principle DC Servomotor with neat diagram. (6)	7 6	BT4 BT-3	Analyze Apply
6	(i) Explain the advantages of AC servomotors. (7)	7	BT4	Analyze

	(ii) What are the difference between stepper motor and servo motor? **(6)**	6	BT-3	Apply
7	Write shorts on the following: (i) Torque-Speed characteristics of servomotor **(6)** (ii) Comparison of AC & DC Servomotors **(7)**	7 6	BT4 BT-3	Analyze Apply
8	Explain the construction and working principle of AC servo motor.	13	BT-3	Applying
9	Summarize the DC servomotor control theory for the following: (i) Field control **(6)** (ii) Armature Control **(7)**	7 6	BT4 BT-3	Analyze Apply
10	Describe traditional and mechatronics concept for bathroom scales.	13	BT4	Analyze
11	Generalize the concept of Car engine management system by mechatronics approach.	13	BT4	Analyze
12	Analyze about Automatic car park barrier system based on mechatronics approach.	13	BT4	Analyze
13	Describe about mechatronics solution for pick and place robot.	13	BT4	Analyze
14	Express about traditional and Mechatronics design process for wind screen wiper.	13	BT3	Apply
15	Describe how engine management system is done in high end vehicles	13	BT3	Apply
16	Sketch the Automatic car park barrier system I used in a toll booth.	13	BT3	Apply

17	Describe about the industrial importance of pick and place robot.	13	BT4	Analyze
18	Differentiate the conventional and mechatronics design process for wind screen wiper.	13	BT4	Analyze

PART-C (15 Marks)

S.No	Questions	Marks	BT Level	Competence
1	Generalize the roles of sensors in car engine management system with a block a diagram.	15	BT6	Create
2	Summarize the fundamental mechatronics aspects involved in bar code reader check-out of a supermarket.	15	BT5	Evaluate
3	Design a digital barometer which will display the atmospheric pressure. You might like to base your solution on the use of the pressure sensor.	15	BT6	Create
4	Recommend a system involving a PLC for the placing on a conveyor belt of boxes in batches of four.	15	BT5	Evaluate
5	Present a case study about the industrial application of pick and place robot.	15	BT6	Create

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