

|  |                                   |
|--|-----------------------------------|
| Program : <b>Diploma in Mechanical Engineering/Tool and Die Engineering / Manufacturing Technology</b> |                                   |
| Course Code : <b>6021A</b>   | Course Title: <b>Mechatronics</b> |
| Semester : <b>6/6/6</b>  | Credits: <b>5</b>                 |
| Course Category: <b>Program Elective/ Program Elective/ Program Elective</b>                           |                                   |
| Periods per week: <b>5 (L:4 T:1 P:0)</b>   | Periods per semester: <b>75</b>   |

### Course Objectives:

- To provide knowledge about mechatronics in manufacturing systems and industries.
- To identify various mechanical, hydraulic, pneumatic, and electrical actuation systems, as well as various types of sensors and their applications.
- To gain an understanding of digital communications concepts and to create PLC programmes.
- To Familiarize with the principles, characteristics, and applications of robotics and automation systems.

### Course Prerequisites:

| Topic   | Course code | Course name                          | Semester |
|---|-------------|--------------------------------------|----------|
| Knowledge of basic Fluid mechanics & Fluid power. |             | Fluid mechanics & Fluid power        | 3        |
| Knowledge of basic Electrical & Electronics       |             | Electrical & Electronics Engineering | 3        |

### Course Outcomes:

On completion of the course,the students will be able to:

| CO <sub>n</sub> | Description  | Duration (Hours) | Cognitive Level |
|-----------------|--|------------------|-----------------|
| CO1             | Describe various types of sensors and their applications.                              | 17               | Understanding   |
| CO2             | Explain the various mechanical, hydraulic, pneumatic and electrical actuation systems. | 21               | Understanding   |

|      |   |    |          |
|------|---|----|----------|
| CO 3 | Explain the basic PLC architecture and PLC programming concepts.                        | 19 | Applying |
| CO4  | Describe automation & robotics systems with specific emphasis on robotic design factors | 16 | Applying |
|      | Series Test   | 2  |          |

### CO – PO Mapping:

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|
| CO1             | 2   |     |     |     |     |     | 2   |
| CO2             | 2   |     |     |     |     |     | 2   |
| CO3             | 3   |     |     |     |     |     | 2   |
| CO4             | 3   |     |     |     |     |     | 2   |

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

### Course Outline:

| Module outcomes | Description  | Duration (Hours) | Cognitive Level |
|-----------------|--|------------------|-----------------|
| CO1             | <b>Describe various types of sensors and their applications.</b>   |                  |                 |
| M1.01           | Mechatronics; Importance of Mechatronics and its applications in modern industries.  | 3                | Understanding   |
| M1.02           | Control systems and their types; Open and Closed-loop control System; Measurement systems; Measurement System terminology. | 3                | Understanding   |
| M1.03           | Different types of sensors   | 6                | Understanding   |
| M1.04           | Selection of sensors   | 2                | Understanding   |
| M1.05           | Application of sensors and controllers in washing machine, automatic water level controller and refrigerators.             | 3                | Understanding   |

#### Contents:

Mechatronics; Importance of Mechatronics and its applications in modern industries; Control systems and their types; Open and Closed-loop control System; Measurement systems; Measurement System terminology - Sensors different types - Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors; Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors. Application of sensors and controllers in washing machine, automatic water level controller and refrigerators.

|            |  |   |               |
|------------|--|---|---------------|
| <b>CO2</b> | <b>Explain the various mechanical, hydraulic, pneumatic and electrical actuation systems.</b>  |   |               |
| M 2.01     | Mechanical actuators - kinematic chain, Geneva mechanism, Mechanical aspects of motor selection.   | 3 | Understanding |
| M 2.02     | Hydraulic and Pneumatic System, -power supply layout- Control valves: Directional control valves- spool valve, poppet valve- pilot operated valve - directional valve, | 3 | Understanding |
| M 2.03     | Pressure control valves -pressure regulating valve - pressure limiting valve and pressure sequence valves- Flow control valves   | 3 | Understanding |
| M 2.04     | Cylinders. - Single acting and double acting - cylinder sequencing- cylinder sequencing in drilling process.   | 3 | Understanding |
| M 2.05     | Process control valve - diaphragm actuators - rotary actuators. Semi rotary actuators.   | 3 | Understanding |
| M 2.06     | Electrical actuation systems: mechanical switches- Relays, solid state switches - diodes -thyristors - triacs - bipolar transistors, Solenoids.                        | 3 | Understanding |
| M2.07      | Working principle and types of AC and DC motors and Stepper motors.  | 2 | Understanding |
| M2.08      | Application of lift operation (Basic only).  | 1 | Understanding |
|            | Series Test – I  | 1 |               |

**Contents:**

Mechanical actuators - kinematic chain, Geneva mechanism, Mechanical aspects of motor selection. Hydraulic and Pneumatic System, -power supply layout- Control valves: Directional control valves- spool valve, poppet valve- pilot operated valve -directional valve, Pressure control valves -pressure regulating valve -pressure limiting valve and pressure sequence valves. Flow control valves. Cylinders. - Single acting and double acting -cylinder sequencing- cylinder sequencing in drilling process, Process control valve - diaphragm actuators - rotary actuators. Semi rotary actuators. Electrical actuation systems: mechanical switches- Relays, solid state switches - diodes -thyristors - triacs - bipolar transistors, Solenoids- working principle and types of AC and DC motors and Stepper motors. Application of lift operation (Basic only).

|            |   |   |               |
|------------|---|---|---------------|
| <b>CO3</b> | <b>Explain the basic PLC architecture and PLC programming concepts.</b>                                 |   |               |
| M3.01      | Programmable Logic Controller (PLC): Definition; Basic block diagram of PLC.                            | 3 | Understanding |
| M3.02      | Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing. | 3 | Applying      |
| M3.03      | PLC mnemonics.  | 3 | Understanding |

|       |  |   |               |
|-------|--|---|---------------|
| M3.04 | Timers; Internal relays and Counters; Shift registers; Master and Jump Controls.                                   | 3 | Understanding |
| M3.05 | Data handling; Analog input/output; Selection of PLC.  | 3 | Applying      |
| M3.06 | Timed switch, Wind-screen wiper motion, Bath room scale; Arduino board, Raspberry pi board, its basic application. | 4 | Understanding |

**Contents:**

Programmable Logic Controller (PLC): Definition; Basic block diagram of PLC; Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics; Timers; Internal relays and Counters; Shift registers; Master and Jump Controls; Data handling; Analog input/output; Selection of PLC. Timed switch, Wind-screen wiper motion, Bath room scale; Arduino board, Raspberry pi board, its basic application.

|            |   |   |               |
|------------|---|---|---------------|
| <b>CO4</b> | <b>Describe automation &amp; robotics systems with specific emphasis on robotic design factors.</b>           |   |               |
| M4.01      | Automation & robotics, Robotic System & Anatomy Classification, Future Prospects.                             | 3 | Understanding |
| M4.02      | Robotic Application in Manufacturing: Material transfer, Machine loading & unloading.                         | 4 | Understanding |
| M4.03      | Processing operations, Assembly & Inspectors Robot Activation & Feedback Components.                          | 3 | Understanding |
| M4.04      | Programming for Robots: Methods, Robot design factors.  | 3 | Applying      |
| M4.05      | Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system. | 3 | Understanding |
|            | Series Test – II  | 1 |               |

**Contents:**

Automation & robotics, Robotic System & Anatomy Classification, Future Prospects. Robotic Application in Manufacturing: Material transfer, Machine loading & unloading, Processing operations, Assembly & Inspectors Robot Activation & Feedback Components, Programming for Robots: Methods, Robot design factors. Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system.

**Text / Reference:**

| <b>T/R</b> | <b>Book Title/Author</b>   |
|------------|--|
| T1         | Mechatronics – W. Bolton, Pearson Education India.   |
| R1         | A Text Book on Mechatronics – R.K.Rajput, S.Chand& Co, New Delhi.  |
| R2         | Mechatronics – M.D.Singh& Joshi, Prentice Hall of India.   |
| R3         | Mechatronics – HMT, Tata McGraw Hill, New Delhi.   |
| R4         | Mechatronics System – Devadas Shetty, PWS Publishing   |
| R5         | Exploring Programmable Logic Controllers with applications – Pradeep Kumar Srivatsava, BPB Publications. |

**Online Resources:**

| <b>S.No</b> | <b>Website Link</b>   |
|-------------|---|
| 1           | <a href="https://youtu.be/zVVITxiec7g">https://youtu.be/zVVITxiec7g</a>       |
| 2           | <a href="https://youtu.be/8Qiy2nf4sp0">https://youtu.be/8Qiy2nf4sp0</a>       |
| 3           | <a href="https://youtu.be/Xl2nWDcy0To">https://youtu.be/Xl2nWDcy0To</a>       |
| 4           | <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> |