



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Automation and Robotics

Subject Code : DI04041061

Subject Name : Automation in Agriculture

| | |
|--------------------------------|---------------------------|
| w. e. f. Academic Year: | 2025-26 |
| Semester: | 4 th |
| Category of the Course: | Professional Elective - I |

| | |
|----------------------|---|
| Prerequisite: | Basic Knowledge of Control Components, Different Control Systems and their symbol. |
| Rationale: | The course on Automation and Robotics Engineering equips engineering diploma students with essential knowledge and skills to operate, maintain, and troubleshoot various agricultural instruments. Students learn to apply fundamental principles of sensing, measurement, and control systems to address real-time industrial challenges while prioritizing safety and sustainability. |

Course Outcome: After Completion of the Course, Student will able to:

| No | Course Outcomes | RBT Level |
|----|--|-----------|
| 01 | Describe automation needs and technological solutions in agriculture. | U |
| 02 | Explain and configure sensors & actuators used in agricultural environments. | R |
| 03 | Demonstrate basic control operations using microcontrollers/PLCs. | A |
| 04 | Use IoT for real-time monitoring of agricultural parameters. | A |
| 05 | Understand automated machinery such as drones, robots, and Smart tractors. | A |

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

| Teaching Scheme (in Hours) | | | Total Credits L+T+(PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|-------------------------------|---|----|-----------------------------|------------------------------|--------|-------|----------------------|----------------|
| L | T | PR | | C | Theory | | Tutorial / Practical | |
| | | | ESE(E) | | PA(M) | PA(I) | ESE(V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |



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Course Content:

| Unit No. | Content | No. of Hours | % of Weightage |
|----------|---|--------------|----------------|
| 1. | Introduction to Agricultural Automation : | 05 | 10 |
| | 1.1.Need and Scope of Automation in Agriculture <input type="checkbox"/> Labour shortage issues and increasing demand for food <input type="checkbox"/> Enhancing productivity, precision, and efficiency <input type="checkbox"/> Reduction in water, fertilizer, pesticide usage <input type="checkbox"/> Role of automation in climate-resilient farming 1.2.Automation in Traditional vs. Modern Farming <input type="checkbox"/> Manual methods vs. mechanized vs. automated systems <input type="checkbox"/> Comparison in cost, time, accuracy 1.3.Components of Agricultural Automation Systems <input type="checkbox"/> Sensors, actuators, controllers, software and communication modules <input type="checkbox"/> Power supply & energy management in fields (solar-based systems) function, output 1.4.Basics of Control Systems <input type="checkbox"/> Open-loop control: timers, simple irrigation systems <input type="checkbox"/> Closed-loop control: sensor-based smart irrigation Feedback control actions, stability (basic concepts) 1.5 Challenges in Agricultural Automation <input type="checkbox"/> Environmental factors: dust, moisture, heat <input type="checkbox"/> Cost, training, maintenance difficulty <input type="checkbox"/> Connectivity challenges in rural areas 1.6.Applications <input type="checkbox"/> Irrigation Automation <input type="checkbox"/> Greenhouse automation <input type="checkbox"/> Soil monitoring system | | |
| 2. | Sensors and Instrumentation in Agriculture | 10 | 20 |
| | 2.1 Introduction to Agricultural Sensors <input type="checkbox"/> Purpose of sensors in field automation <input type="checkbox"/> Classification: environmental, soil, crop, machinery sensors 2.2 Soil Monitoring Sensors <input type="checkbox"/> Soil moisture sensor (resistive, capacitive) – working principle <input type="checkbox"/> Soil temperature sensors – thermistors /RTDs <input type="checkbox"/> Soil nutrient sensors (NPK sensors) – spectroscopy basics | | |



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| | <p>2.3 Weather and Environment Sensors</p> <ul style="list-style-type: none"> <input type="checkbox"/> Humidity sensors (capacitive/psychrometric) <input type="checkbox"/> Temperature sensors (LM35, DHT11/22) <input type="checkbox"/> Rain sensors, wind speed (anemometer), wind direction <p>2.4 Water and Irrigation Sensors</p> <ul style="list-style-type: none"> <input type="checkbox"/> Water level sensors: float, ultrasonic <input type="checkbox"/> Water flow sensors (turbine type) <input type="checkbox"/> Pressure sensors for pump automation <p>2.5 Smart Animal and Crop Sensors</p> <ul style="list-style-type: none"> <input type="checkbox"/> RFID tags for livestock <input type="checkbox"/> Health monitoring wearable sensors <input type="checkbox"/> Light intensity sensors (LDR) for crop growth monitoring <p>2.6 Sensor Interfacing & Signal Conditioning</p> <ul style="list-style-type: none"> <input type="checkbox"/> Analog vs. digital sensors <input type="checkbox"/> ADC, noise filtering, linearization <input type="checkbox"/> Power requirements, calibration techniques <p>2.7 Data Acquisition Principles</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sampling, data logging, storage <input type="checkbox"/> Real-time vs. periodic sensing <input type="checkbox"/> Introduction to DAQ systems for farms | | |
| 3. | Control Systems & Microcontroller Applications | 10 | 20 |
| | <p>3.1 Basics of Microcontrollers for Agriculture</p> <ul style="list-style-type: none"> • Arduino, ESP32, Raspberry Pi: features & comparison • GPIO, PWM, ADC, communication ports <p>3.2 Introduction to Programmable Logic Controllers (PLC)</p> <ul style="list-style-type: none"> • Basic architecture • Ladder logic basics • Use of PLCs in pump control, greenhouse systems <p>3.3 Actuators in Agriculture</p> <ul style="list-style-type: none"> • DC motors, servo motors, stepper motors • Solenoid valves for irrigation • Relay modules for pump control • Sprayer pump automation <p>3.4 Automation of Irrigation Systems</p> <ul style="list-style-type: none"> • Soil-moisture based irrigation • Timer-controlled irrigation • Drip and sprinkler automation techniques <p>3.5 Greenhouse Automation</p> <ul style="list-style-type: none"> • Temperature and humidity control • Ventilation fan control | | |



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| | <ul style="list-style-type: none"> • Fogger and misting system control • CO2 monitoring basics | | |
| 4. | IoT and Communication Technologies in Agriculture | 10 | 25 |
| | 4.1 Introduction to IoT in Agriculture <ul style="list-style-type: none"> • Concept of connected farms • IoT architecture 4.2 IoT Hardware for Agriculture <ul style="list-style-type: none"> • ESP8266/ESP32 microcontrollers • IoT nodes with sensors • Edge computing basics 4.3 Communication Technologies <ul style="list-style-type: none"> • Wi-Fi: greenhouses and small farms • GSM/4G/5G modules for mobile-based monitoring • LoRa and LoRaWAN: long distance, low power • ZigBee: sensor networks • Bluetooth for short-range wireless control 4.4 Cloud Platforms for Agriculture <ul style="list-style-type: none"> • Thing speak, Blynk, Firebase (introductory overview) • Data uploading, visualization graphs • Real-time monitoring dashboards 4.5 Automation Using Mobile Apps <ul style="list-style-type: none"> • Pump ON/OFF via mobile • Real-time soil moisture alerts • SMS-based automation controls | | |
| 5. | Robotics & Advanced Automation in Agriculture | 10 | 25 |
| | 5.1 Introduction to Agri-Robotics <ul style="list-style-type: none"> • Definition and importance • Global trends in farm robotics • Overview of robotic systems 5.2 Drones in Agriculture <ul style="list-style-type: none"> • Types of agricultural drones • Drone components (GPS, IMU, cameras, sprayer tank) • Drone applications: <ul style="list-style-type: none"> • Crop spraying • Seed sowing • Crop health mapping • NDVI imaging basics 5.3 Autonomous Machinery <ul style="list-style-type: none"> • Self-driving tractors: sensors, LiDAR, GPS | | |



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| <ul style="list-style-type: none">• Combine harvesters• Robotic planters 5.4 Robotics for Specific Tasks <ul style="list-style-type: none">• Robotic weeders• Fruit picking robots• Seedling transplanters• Milking robots in dairy farms 5.5 Machine Vision in Agriculture <ul style="list-style-type: none">• Basics of image processing• Crop disease detection• Ripeness detection• Weed identification | | |
| Total | 45 | 100 |

Suggested Specification Table with Marks (Theory):

| Distribution of Theory Marks (in %) | | | | | |
|-------------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 40% | 40% | 20% | - | - | - |

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Principles of Agricultural Engineering, Vol 1 & 2 by A.M. Michael and T.P. Ojha
2. Elements of Agricultural Engineering by Jagdishwar Sahay
3. Farm Machinery and Equipment by Harris Pearson Smith.
4. Fundamentals of Agricultural and Field Robotics edited by Manoj Karkee and Qin Zhang.
5. Agricultural Automation: Fundamentals and Practices edited by Qin Zhang and Francis J. Pierce
6. Smart Agriculture Automation Using Advanced Technologies: Data Analytics and Machine Learning, Cloud Architecture, Automation and IoT by Amitava Choudhury et al
7. Robotics and Automation for Improving Agriculture edited by Prof John Billingsley.
8. Agricultural Informatics: Automation Using the IoT and Machine Learning by Amitava Choudhury et al
9. AI, Edge and IoT-based Smart Agriculture by Ajith Abraham et al
10. Precision Agriculture Technology for Crop Farming by Qin Zhang



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(b) Open source software and website:

1. <https://www.arduino.cc>
2. <https://nodered.org>
3. <https://thingsboard.io> 4. <https://opencv.org>
5. <https://qgis.org>
6. <https://www.opendronemap.org>
7. <https://www.freecadweb.org> 8. <https://python.org>
9. <https://www.openhab.org>
10. <https://farm.bot>
11. <https://agopengps.com>
12. <https://www.opensourceecology.org>
13. <https://github.com>
14. <https://www.instructables.com>

Suggested Course Practical List: If any

| Sr. No. | Practical Outcomes (PrOs) | Unit No. | Approx. hours required. |
|---------|---|----------|-------------------------|
| 1 | Study of basic automation components: sensors, actuators, relays, valves etc. | 1 | 2 |
| 2 | Installation and configuration of soil moisture sensors. | 1 | 2 |
| 3 | Calibration and testing of temperature and humidity sensors. | 1 | 4 |
| 4 | Interface soil moisture sensor with microcontroller (Arduino/Raspberry Pi). | 1 | 4 |
| 5 | Design and testing of an automated drip irrigation system. | 1 | 4 |
| 6 | Programming microcontroller for threshold based irrigation control. | 2 | 2 |
| 7 | Study & implementation of IoT based data logging using open source platforms. | 2 | 4 |
| 8 | Create a simple dashboard for monitoring agricultural parameters. | 2 | 4 |
| 9 | Motor and pump automation using relay or motor driver circuits. | 3 | 2 |
| 10 | Study of greenhouse climate control systems. | 3 | 2 |
| 11 | Design and test an automated greenhouse ventilation system. | 3 | 2 |
| 12 | Study and calibration of soil moisture sensor. | 3 | 2 |
| 13 | Automation of irrigation system using relay and water pump. | 3 | 2 |
| 14 | Sensor data logging to cloud platform. | 4 | 2 |
| 15 | Setup of greenhouse monitoring system | 4 | 2 |
| 16 | Motor control using microcontroller. | 4 | 2 |
| 17 | Demonstration of agricultural drone controls. | 4 | 2 |
| 18 | IoT based plant monitoring system. | 4 | 2 |
| 19 | Visualisation effect of plant nutrient of growth of crop. | 5 | 2 |
| 20 | Central monitoring of farmer sown fields. | 5 | 2 |



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List of Laboratory/Learning Resources Required:

Farm Machinery : Hands-on experience with both basic and modern equipment is crucial.

- o Tractors and Power Tillers (including cut-sections for study) o Tillage equipment (ploughs, harrows, cultivators)
- o Seeding and planting machinery (seed drills, precision planters)
- o Sprayers and Dusters (manual, engine-operated, and tractor-mounted types) o Harvesting machines (reapers, threshers, combine harvesters)
- o Irrigation systems (drip and sprinkler systems, pumps, valves, and related plumbing components)

Automation Hardware

- o Programmable Logic Controllers (PLCs) for control system programming
- o Sensors: Soil moisture, temperature, pH, EC (electrical conductivity), humidity, and light intensity sensors
- o Microcontrollers and single-board computers (e.g., Arduino, Raspberry Pi) for interfacing with sensors and actuators
- o Actuators: Relays, motor drivers, motors (stepper, servo, DC), solenoid valves
- o Robotic components for pick-and-place mechanisms or simple agricultural robots
- o Drones (UAVs) equipped with cameras (standard and infrared) for field monitoring o GPS receivers and auto-guidance systems for precision farming applications
- o Basic electronic lab equipment: Multimeters, oscilloscopes, power supplies, soldering/de-soldering stations, and various electronic components (resistors, capacitors, etc.)

General Agriculture Lab Equipment

- o Soil and water testing kits, pH meters, EC meters, and flame photometers
- o Weighing balances, ovens, incubators, and autoclaves
- o Weather station

Software Tools:

- o PLC programming software (e.g., for ladder logic creation)
- o SCADA (Supervisory Control and Data Acquisition) software for developing graphic screens and control interfaces
- o Geographic Information System (GIS) software for mapping and data analysis
- o Programming IDEs for microcontrollers (e.g., Arduino IDE, Python environment)
- o AI and Machine Learning platforms (access to relevant case studies or basic implementation tools)
- o Simulation software for modeling agricultural processes and automation systems.

Suggested Project List:

- 1 Image processing based automatic sugarcane butt cutter
- 2 Solar powered electric tiller
- 3 Mobile control Multi-purpose Agriculture Vehicle for Seed sowing with weed remover and



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fertilizer sprayer

4 Advanced wireless Automatic digital pumping System for Agriculture using Sensor

5 Solar Seed Dryer with auto tracking

6 Biogas production from kitchen waste

7 Amphibious vehicle (bicycle) for land and water

8 Fully automatic 2 Layer Hydroponics farming in agricultural field

9 Automatic fertilizer mixing machine using PLC

10 Bluetooth control Multipurpose agriculture vehicle for grass cutter, seed sowing, water spraying with weed remover

11 Fruit Ripening For Farmers

12 Hybrid Solar & Wind Power Generation and water pumping System for agriculture

13 Pedal operated biomass briquetting Machine

14 Solar powered soil digging with grass cutter and water spraying vehicle

15 Gas Converted Power Sprayer

16 Solar remote control Seed Sowing Machine

17 Rubber tree tapping Machine

18 Remote controlled solar Seeds Sprayer

19 Pendulum based Water pumping System

20 Pneumatic ground driller

21 Solar grass Cutter with Water spraying System

22 Crank shaft operated agriculture cutter

23 Combined solar powered waste plastic collector cum drum type oil skimmer

24 Solar Multi-purpose seed and Agro Sprayer

25 Multifunctional innovative aqua phonics system

26 Pepper Thresher Machine

27 Eccentric vegetable cutting Machine

28 Air powered mixie

29 Autonomous Anti-drowning system in car during flood

30 Remote controlled Multi-purpose floor Cleaning Vehicle

31 Solar scroll saw machine / Solar switch board cutter

32 Six leg Robot for Agriculture purpose which can spray Seed and water

33 Hydraulic manure spreader Vehicle

34 Floating Water bike

35 Solar air Dryer with Auto Tracking

36 Fabrication of Farm kart Vehicle

37 Seed ball plantation by using Geneva wheel mechanism

38 Maize De-Husker

39 Various types of Irrigation System

40 Nutmeg Shell removing machine

41 Automatic drainage cleaning and detection of toxic gases



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- 42 Motorized coconut oil/Milk Extraction Machine
- 43 Coconut grater and milk extractor
- 44 Water Pumping System using Vertical Wind Power
- 45 IoT based soil nutrition monitoring system
- 46 Combination of Agri cutter cum excavation machine
- 47 Automatic conveyor based Vegetable cutter
- 48 Solar powered Tea leaf cutting Machine
- 49 Solar Birds Scarer
- 50 Born shredder / coconut shell shredder
- 51 Solar rice de-husking machine
- 52 Pedal operated Coconut peeling Machine
- 53 Coconut shredder with squeezer / Coconut scrapper cum milk extraction machine
- 54 Trash Wheel for river cleaning
- 55 Automatic Ginger cutting, feeding and drying Machine
- 56 Automatic onion/Tomato/potato sorting machine
- 57 Low cost harvesting Machine
- 58 Automatic Fault Egg Sorting Machine
- 59 Trolley mounted fertilizer Spreader
- 60 Remote controlled Coconut Tree Climber
- 61 Pneumatic scissor jack for loading vegetables to lorry
- 62 Solar operated agricultural multi-blade weeder
- 63 Motorized fertilizer blender
- 64 Virgin coconut oil maker
- 65 Agriculture model pump for garden
- 66 Drainage/ Sewage cleaning Machine
- 67 Laminar flow Water fountain
- 68 Engine powered weeder removing vehicle
- 69 Coconut Tree sprayer
- 70 Trash Removal system in water bodies
- 71 Automatic weighing and Sealing Machine
- 72 Solar operated Grass cutter, Seed Sowing and weed cutting Machine
- 73 Sun flower harvesting Machine
- 74 Semi-automatic copra coconut cutting machine
- 75 Beans Sheller Machine

Suggested Activities for Students: If any

In addition to classroom and laboratory learning, students are encouraged to engage in co- curricular activities that enhance their understanding and practical skills. These activities can be conducted in



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groups and should be documented in 5-page reports. Collecting physical evidence of their work will also contribute to their portfolio, which can be valuable during placement interviews

- Collaborate in groups to create detailed specifications for various industrial measuring devices. Consider accuracy, range, resolution, and environmental factors.
- Form teams and work on small –scale agri-instrument projects. Apply theoretical knowledge to practical scenarios, such as designing a temperature control system or flow measurement setup.
- Deliver a seminar on safety practices specific to agri-instrument systems. Cover topics like hazard identification, risk assessment, and emergency protocols.
- Organize a seminar focusing on cutting -edge agri-instrument technologies. Discuss trends, innovations, and their applications in industry.
- Conduct a comprehensive market survey to explore available industrial components (sensors, transducers, controllers, etc.). Analyze their features, costs, and suitability for different applications.
- Prepare portfolios showcasing your agri-instrumentation related work. Include project report, photographs, and evidence of practical implementation.

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