MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS			
SIGNATURE COURSE			
Name of the College	D B Pampa College, Parumala		
Faculty/ Discipline	Physics		
Programme	BSc (Hons) Physics		
Course Coordinator	SATHYAJITH S		
Contributors	DR. AJITH S KUMAR, DR. SAJAN P, DR. ASWATHY G, DR. SATHEESH M, DR. SARATH S NAIR (SCIENTIST G, SCTIMST)		
Course Name	Sensors, Actuators, and Microcontrollers		
Type of Course	DSE		
Specialization title	Automation and Control Applications		
Course Code	MG3DSEPHYA06		
Course Level	200		
Course Summary	This course empowers learners to prototype automation systems using Arduino and ESP32. By interfacing sensors and actuators, students develop practical skills in embedded programming and IoT connectivity, fostering the critical thinking and analytical reasoning essential for modern automation and control applications.		
Semester	3	**Credits**	4

Course Details

Learning Approach	Lecture	Practical/Lab-P	Total Hours
Credits	3	1	75

Pre-requisites, if any	Knowledge in Basic Electronics

Course Outcomes (CO)

Number of COs		4	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the architecture of microcontrollers (Arduino/ESP32) and the software development environment.	U	PO1, PO2
2	Develop programs using C++ syntax (control structures, loops, functions) to process digital and analog signals	A	PO1, PO2
3	Construct circuits by interfacing various sensors and actuators with microcontrollers to solve physical problems.	C	PO1, PO2
4	Design wireless IoT applications using Arduino and ESP32 for remote monitoring and web-based control.	C	PO1, PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	1	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Sensors, Microcontrollers & Arduino Ecosystem			
	1.1	Hardware Overview: Introduction to Sensors, Digital vs Analog Sensors. Analogue to Digital Convertor. Difference between Microcontrollers and Microprocessors. Arduino Uno Architecture: ATmega328P features, Pin configuration (Digital/Analog/PWM), Powering the board.	5	["1", "3"]
	1.2	The Programming Environment (IDE): Installation of IDE and Drivers. Anatomy of a Sketch: void setup() vs void loop(). Compilation and Uploading process.	5	["1", "2"]
	1.3	Basic Programming & Digital I/O: Syntax for variables and data types. Usage of pinMode(), digitalWrite(), analogRead(), delay(). Implementing Control Structures: for loops and while loops for LED patterns.	7	["2"]
	1.4	Serial Communication: Understanding UART. Using Serial.begin(), Serial.print(), and Serial.println() for debugging and visualizing variable data on the Serial Monitor.	4	["2"]
2	Sensors, Actuators, and Interfacing			
	2.1	Interfacing Sensors (Inputs): Working principle and interfacing of Ultrasonic Sensor (HC-SR04), LDR (Light Dependent Resistor), and MQ2 Gas Sensor. Using analogRead() and voltage dividers.	3	["3"]
	2.2	Interfacing Actuators (Outputs): Arduino Digital Output, Pulse Width Modulation (PWM) theory (analogWrite). Controlling Servo Motors (Angle control). Driving Geared DC Motors using L293D/L298N Driver Modules.	5	["3"]
	2.3	Integrated Logic: Combining inputs and outputs. Designing automated logic (e.g., "If distance < 10cm, stop motor"). Building decision-making systems.	5	["2", "3"]
3	Introduction to Wireless communication using Microcontrollers			
	3.1	Wireless Communication using Arduino: Wi-Fi, Bluetoothinterfacing with arduino.	3	["1"]
	3.2	Bluetooth & Mobile Interfacing: Introduction to Bluetooth Serial (Classic). Interfacing with Smartphone Bluetooth Terminal apps to control actuators (LEDs/Motors) remotely.	5	["4"]
	3.3	ESP32 Architecture: Comparison with Arduino (Speed, Wi-Fi, Bluetooth). Pinout of ESP32 Dev Kit V1. Installing ESP32 Board Manager in Arduino IDE.	3	["4"]

Module	Units	Course Description	Hrs	CO No.
4	Practical / Simulation			
	4.1	Hello World: Write a program to blink the onboard LED and an external LED with different delay intervals	2	["1"]
	4.2	Traffic Light Controller: Design a 3-way traffic signal system using Red, Yellow, and Green LEDs with specific timing sequences.	2	["2"]
	4.3	SOS Signaller: specific program to create an SOS distress signal (3 short, 3 long, 3 short flashes) using an LED.	2	["2"]
	4.4	RGB Mixer: Interface a Tricolor (RGB) LED and generate different colors using PWM.	2	["2", "3"]
	4.5	Smart Street Light: Create a system that automatically turns on an LED when the room gets dark using an LDR.	2	["3"]
	4.6	Distance Meter: Interface an HC-SR04 Ultrasonic sensor to measure distance and display it on the Serial Monitor.	2	["3"]
	4.7	Parking Assistant: Design a reverse parking indicator where a buzzer beeps faster as an object gets closer (Ultrasonic + Buzzer).	2	["3"]
	4.8	Fire Alarm: Build a safety system that triggers a buzzer when a flame or smoke (MQ2) is detected.	2	["3"]
	4.9	Digital Thermometer: (Optional if LM35/DHT sensor available) Read temperature data and display it.	2	["3"]
	4.10	Robotic Arm Control: Control the position (0 to 180 degrees) of a Servo Motor using a potentiometer.	2	["2", "3"]
	4.11	DC Motor Speed Control: Vary the speed of a DC Fan/Motor using a potentiometer and PWM	2	["2", "3"]
	4.12	Line Follower Logic: Interface two IR sensors and write a program to detect a black line on a white surface	2	["3"]
	4.13	Bluetooth Remote: Control a DC motor or LED using commands sent from a smartphone via Bluetooth Classic	2	["4"]
	4.14	The Serial Command Processor: create a program where the user inputs two numbers and an operator (e.g., 10 + 5) via the Serial Monitor and obtain result from Arduino	2	["1", "2"]
	4.15	Develop a pedestrian crossing signal system with push-button control.	2	["1", "2"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture, Practical, Demonstration

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Quiz, Assignment, Seminar **• Practical – 15 Marks** Lab involvement, Viva **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written Test Duration of Examination – 1.50 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B Answer Type: ◦ PART - A ◦ Short answer - (10 out of 14) – 10 × 2 = 20 ◦ PART - B ◦ Short Essays - (6 out of 8) – 6 × 5 = 30 **• Practical – 35 Marks** Assessment Methods – Lab Exam, Record Duration of Examination – 2.00 Hrs

References

- Misra, Yogesh, Programming and Interfacing with Arduino, CRC Press, 2021
- Zulfiqar, Asim, Hands-on ESP32 with Arduino IDE, Packt Publishing, 2024

Suggested Readings

- https://spoken-tutorial.org/

Affidavit

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Contributors	DR. AJITH S KUMAR, DR. SAJAN P, DR. ASWATHY G, DR. SATHEESH M, RAHUL VIJAYARAGHAVAN (AI SOFTWARE SOLUTIONS ENGINEER, INTEL INDIA)		
Course Name	Computational Techniques for Automation		
Type of Course	DSE		
Specialization title	Automation and Control Applications		
Course Code	MG4DSEPHYA06		
Course Level	200		
Course Summary	This course equips learners with Python and Machine Learning skills to solve complex engineering problems. By mastering data analysis and algorithms like K-Nearest Neighbors, random forest, and decision tree, students develop the critical ability to design intelligent automation systems and analyze real-world data trends.		
Semester	4	**Credits**	4
Course Details	**Learning Approach** / **Lecture** / **Practical/Lab-P** / **Total Hours** Credits / 3 / 1 / 75		
Pre-requisites, if any	Basic logical reasoning and mathematics		

Course Outcomes (CO)

Number of COs		4	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the principles of AI, Machine Learning, and Neural Network architectures, including their ethical and safety implications.	U	PO1, PO2
2	Utilize Python, version control, and libraries (Pandas, Scikit-learn) to manipulate data and implement core machine learning models	A	PO1, PO2
3	Build, optimize, and benchmark Deep Learning models using frameworks like PyTorch and advanced optimization techniques	C	PO1, PO2
4	Apply Generative AI, LLMs, and Prompt Engineering strategies to automate complex tasks and solve real-world engineering problems	A	PO1, PO2

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CO 2	3	2	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	AI Fundamentals & Data Science			
	1.1	Overview of AI & Machine Learning: Concepts of Neural networks(Introduction to PyTorch framework), Machine Learning systems, and main challenges. Applications in business and automation. Generative AI and Large Language Models (LLMs), AI agents, and LLM-based task automation.	4	["1", "4"]
	1.2	Python ML Ecosystem Overview:NumPy, Pandas, Matplotlib, Scikit-learn, PyTorch/Lightning AI.(orientation only.)	1	["2"]
	1.3	Data Management with Pandas: Importing and exporting data (CSV/Excel/JSON) using Python (Pandas library). Slicing and dicing data sets.	5	["2"]
	1.4	Database Interaction: Extracting data from local or remote databases using Python scripts. Handling basic SQL queries within Python. Data Preprocessing & visualization: Data preprocessing (Handling missing values: isnull() , dropna() , fillna() , imputation strategies.). Data Visualization Using Matplotlib and Seaborn (Line plots, Scatter plots)	5	["2"]
2	Machine Learning & Implementation			
	2.1	ML Categories: Scikit-learn, Overview of Supervised, Unsupervised, and Reinforcement learning. Differences and use-cases in industry.	3	["1"]
	2.2	Supervised Learning (Classification): Theory and implementation of K-Nearest Neighbors (KNN) using Scikit-learn. Decision Tree and Random Forest algorithms (Qualitative). Selecting appropriate classification models.	5	["2"]
	2.3	Regression Analysis: Concept of regression. Implementing Linear Regression (Single Variable) for predictive maintenance or forecasting.	4	["2"]
	2.4	Unsupervised Learning: K-Means Clustering, Hierarchical Clustering techniques. Grouping data points without labeled training data. (Principal Component Analysis) for dimensionality reduction	3	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Applied Automation & Emerging AI			
	3.1	Optimization Algorithms: Concept of Gradient Descent algorithms. Understanding how algorithms optimize error functions in automation. Loss functions, convergence concepts. RMSprop and Hyperparameter tuning (Qualitative)	5	["3"]
	3.2	Introduction to deep learning Fundamentals of the Perceptron, common activation functions (ReLU, Sigmoid), and a conceptual overview of forward and backward propagation. The PyTorch Framework: Introduction to tensors and the basic structure of a PyTorch neural network. Normalization in deep learning, Regularization in deep learning, Compare PyTorch neural network performance vs. KNN on same dataset.	5	["3"]
	3.3	LLM Fundamentals & Tokenization: Architecture Overview, Data Representation,The LLM Landscape: Brief comparison of proprietary (GPT, Gemini) vs. Open-source models (Llama, Mistral) and REST API patterns. Prompt Engineering & RAG: Prompting Techniques, Retrieval-Augmented Generation (RAG). Ethics & Safety: Responsible AI	5	["1", "4"]
4	Practical			
	4.1	Logic Gates Implementation: Write a Python program to simulate basic logic gates (AND, OR, NOT) based on user input	2	["2"]
	4.2	Number Analysis: Script to identify largest and smallest numbers in a user-provided dataset.	2	["2"]
	4.3	Bitwise Data Toggling: Function to simulate microcontroller port operations via bit toggling	2	["2"]
	4.4	String Parsing: Program to extract relevant values from simulated sensor data strings	2	["2"]
	4.5	CSV Data Processor: Using Pandas to load CSV files and perform statistical calculations like mean.	2	["2"]
	4.6	Database Data Extractor: Python script to connect to a database and extract specific rows based on conditions.	2	["2"]
	4.7	Signal Plotter: Generating numerical values for a Sine wave and plotting using Matplotlib	2	["2"]
	4.8	Noise/Outlier Filter: Identifying values that deviate significantly from a calculated average in a data stream.	2	["2"]
	4.9	Handwritten Digit Recognition (KNN): Implementing the KNN algorithm using the MNIST dataset.	2	["4"]
	4.10	Gradient Descent Simulation: Demonstrating optimization logic by finding the minimum of a mathematical function.	2	["3"]
	4.11	Disease Prediction Model: Building a classification model to predict presence based on medical data.	2	["4"]
	4.12	House Price Prediction: Implementing Single Variable Linear Regression for price forecasting	2	["4"]
	4.13	Unsupervised Clustering: Applying Hierarchical Clustering to group similar data points.	2	["3"]
	4.14	System Fault Classifier: Logic-based script to classify machine status (Running, Idle, Error)	2	["4"]
	4.15	Regression Visualization: Performing linear regression and generating a "Best Fit Line" plot.	2	["2", "4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture, Practical, Demonstration

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Quiz, Assignment, Seminar **• Practical – 15 Marks** Lab involvement, Viva **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written Test Duration of Examination – 1.50 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B Answer Type: ∘ PART - A ∘ Short answer - (10 out of 14) – 10 × 2 = 20 ∘ PART - B ∘ Short Essays - (6 out of 8) – 6 × 5 = 30 **• Practical – 35 Marks** Assessment Methods – Lab Exam, Record Duration of Examination – 2.00 Hrs

References

- Raschka, S., Liu, Y., & Mirjalili, V. ,Machine Learning with PyTorch and Scikit-Learn. Packt Publishing (2022)
- VanderPlas, J., Python Data Science Handbook (2nd Ed.). O'Reilly Media (2022)
- Zhang, A., et al,. Dive into Deep Learning, d2l.ai, (2023)

Suggested Readings

- Scikit-Learn: scikit-learn.org
- PyTorch: pytorch.org/tutorials
- Tunstall, L., et al., Natural Language Processing with Transformers. O'Reilly Media, (2022)

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Contributors	DR. AJITH S KUMAR, DR. SAJAN P, DR. ASWATHY G, DR. SATHEESH M, DR. SARATH S NAIR (SCIENTIST G, SCTIMST)		
Course Name	Embedded Systems & IoT		
Type of Course	DSE		
Specialization title	Automation and Control Applications		
Course Code	MG5DSEPHYA06		
Course Level	300		
Course Summary	This course transitions learners from microcontrollers to advanced embedded computing using Raspberry Pi and ESP32. Students master Python for hardware control, design GUIs with Tkinter, and implement IoT protocols like MQTT and HTTP to build integrated, wireless smart systems.		
Semester	5	**Credits**	4
Course Details			

Learning Approach	Lecture	Practical/Lab-P	Total Hours
Credits	3	1	75

Pre-requisites, if any	Basic electronics, microcontroller interfacing, and programming.

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the architecture of ESP32 and Raspberry Pi systems and their role in the IoT ecosystem.	U	PO1, PO2, PO3
2	Apply Python programming concepts to control GPIO pins and interface sensors with embedded Linux systems.	A	PO1, PO2, PO3
3	Analyze different IoT communication protocols (HTTP, MQTT) for transmitting sensor data to cloud dashboards.	An	PO1, PO2, PO3
4	Create Graphical User Interfaces (GUI) and integrated IoT solutions utilizing cameras and wireless connectivity.	C	PO1, PO2, PO3

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CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	1	3	-	-	-	-	-	-	-
CO 2	2	3	3	-	-	-	-	-	-	-
CO 3	3	2	2	-	-	-	-	-	-	-
CO 4	3	3	3	-	-	-	-	-	-	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	IoT Data Acquisition & Firmware Management			
	1.1	Sensor Data Processing: Reading multiple sensors (e.g., Temperature, LDR) on ESP32. Formatting data (Strings/JSON) for transmission.	3	["2"]
	1.2	Basic Wi-Fi Control : Connecting to Wi-Fi (Station Mode). Creating a synchronous "Hello World" Web Server to toggle an LED ON/OFF via a browser.	3	["3"]
	1.3	wireless monitoring (dashboard): Creating an Asynchronous Web Server to host a local dashboard that displays real-time sensor readings (Auto-refreshing web page).	2	["1"]
2	Raspberry Pi Architecture & Python GPIO			
	2.1	Raspberry Pi Essentials: Introduction to Raspberry Pi models. Port layout of RPi 4. OS Installation (Raspberry Pi OS) and configuration. Introduction to the Linux terminal basics.	4	["1"]
	2.2	Python for Embedded: Review of Python structure. Introduction to Thonny IDE. Importing system libraries for hardware control.	3	["2"]
	2.3	GPIO Programming: Understanding the RPi GPIO header. Initializing I/O pins. Using the RPi.GPIO or gpiozero library. Functions for Digital Read and Digital Write.	4	["2"]
	2.4	Interfacing Modules: Controlling LEDs, buzzers, LED display and reading button inputs using Python. Debouncing switches via software.	4	["2"]
3	Advanced GUI & IoT Applications			
	3.1	GUI Programming with Tkinter: Overview of Tkinter library. Creating windows and widgets (Labels, Buttons, Entry boxes). Customizing widget properties.	4	["4"]
	3.2	Geometry Managers & Logic: Using pack, grid, and place managers to design layouts. Linking GUI buttons to hardware actions (e.g., Click button -> Turn ON LED).	5	["4"]
	3.3	Multimedia & Camera: Interfacing the Raspberry Pi Camera Module. Capturing images and video using Python scripts.	6	["4"]
	3.4	Cloud & Protocols: Introduction to OTA (Over-The-Air) updates. Concept of flashing new firmware wirelessly without a physical USB connection. Introduction to MQTT protocol (Publish/Subscribe model). Sending RPi/ESP32 data to a cloud platform (e.g., ThingsSpeak or HiveMQ).	7	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Practical / Simulation			
	4.1	Wireless Data Logger: specific program to read temperature/light data and display it on a simple HTML webpage hosted by the ESP32	2	["1", "3"]
	4.2	Smart Switch (Web Server): Create a local web server with "ON" and "OFF" buttons to control a relay or LED remotely via smartphone.	2	["3"]
	4.3	OTA Update Simulation: perform a basic Over-The-Air (OTA) update to change the blink frequency of an LED without reconnecting the USB cable.	2	["3"]
	4.4	Cloud Dashboard: Configure the ESP32 to send sensor data to a free cloud dashboard (like ThingSpeak) and visualize the graph.	2	["3"]
	4.5	Hello GPIO: Write a Python script to blink an LED connected to a specific GPIO pin on the Raspberry Pi.	2	["1", "2"]
	4.6	Button Control: Interface a push button and an LED. Write a script to toggle the LED state each time the button is pressed.	2	["2"]
	4.7	Traffic Light Sim: Simulate a traffic light sequence using 3 LEDs (Red, Yellow, Green) and Python time delays.	2	["2"]
	4.8	Sequencer: Connect 8 LEDs to the GPIO port and write a program to create a "running light" pattern.	2	["2"]
	4.9	GUI Switch: Create a desktop application using Tkinter with a button that turns an external LED ON and OFF when clicked.	2	["4"]
	4.10	Sensor Monitor GUI: Design a Tkinter window that updates and displays the status of a GPIO input (High/Low) in real-time.	2	["4"]
	4.11	Login System: Create a basic GUI login screen that prints "Access Granted" to the console only when correct credentials are entered.	2	["4"]
	4.12	Spy Camera: Write a Python script to capture an image/video using the Pi Camera when a motion sensor (PIR) is triggered.	2	["4"]
	4.13	MQTT Publisher: Configure the Raspberry Pi to publish "Hello World" or sensor data to a public MQTT broker.	2	["3"]
	4.14	Voice Alert: Write a script that plays a specific audio file (using a speaker connected to the Pi) when a button is pressed.	2	["2"]
	4.15	Smart Home Hub: Create a system where the Raspberry Pi acts as a central hub, receiving data from an ESP32 node via Wi-Fi and displaying it on a Tkinter GUI.	2	["4"]

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References

- Zulfiqar, Asim, Hands-on ESP32 with Arduino IDE, Packt Publishing, 2024
- Molloy, Derek, Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux, Wiley, 2016

Suggested Readings

- Smar, Garry, Practical Python Programming for IoT, Packt Publishing Limited, 2020

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Course Name	Industrial Automation & PLC Logic		
Type of Course	DSE		
Specialization title	Automation and Control Applications		
Course Code	MG6DSEPHYA06		
Course Level	300		
Course Summary	This course provides a comprehensive understanding of industrial automation, covering Industry 4.0 standards, sensors, and robotic actuators. Students will master Programmable Logic Controller (PLC) architecture and Ladder Logic programming to design and troubleshoot automated solutions for real-world tasks like conveyor belts and pick-and-place systems		
Semester	6	**Credits**	4
Course Details	**Learning Approach** / **Lecture** / **Total Hours**: Credits / 4 / 60		
Pre-requisites, if any	Foundational knowledge of basic electronics and digital logic gates		

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain the principles of Industrial Automation, Industry 4.0, and the evolution of robotics	U	PO1, PO2
2	Apply ladder logic programming techniques to control PLCs for specific industrial tasks	A	PO1, PO2
3	Analyze various sensors (Piezo, PIR) and actuators (Stepper/Servo) for appropriate selection in automation systems	An	PO1, PO2
4	Design and develop automated solutions, such as conveyor systems or water level monitors, using simulation tools	C	PO1, PO2

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CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	2	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Industrial Hardware & Robotics			
	1.1	Introduction to Robotics: Evolution of robotics and basic concepts. Definition and purpose of Industrial Automation.	3	["1"]
	1.2	Industry 4.0: Overview of modern industry standards and types of industrial automation systems.	3	["1"]
	1.3	Industrial Sensors: Basic concepts and working principles of Piezoelectric sensors, IR proximity sensors, and Passive Infrared (PIR) sensors.	5	["3"]
	1.4	Actuators & Motors: Basic concepts of Servo Motors and Stepper Motor. Introduction to Electrical Actuators used in industrial setup	4	["3"]
2	PLC Architecture & Programming			
	2.1	Introduction to PLCs: Different types of PLCs, Inputs and Outputs (I/O) architecture, and Types of I/O Modules.	4	["2"]
	2.2	Ladder Logic Basics: Fundamentals of Ladder Logic programming. Implementation of basic Logic Gates (AND, OR, NOT) within PLC software.	5	["2"]
	2.3	Hardware Interfacing I: Interfacing PLCs with visual indicators (LEDs) and Motors.	3	["2"]
	2.4	Hardware Interfacing II: Interfacing PLCs with sensors, specifically connecting PIR sensors for motion detection logic.	3	["2"]
3	Control Systems & Real-World Applications			
	3.1	Control Systems: Role of control systems in robotics. Example of Closed-loop control systems (e.g., Automatic water level system).	5	["1"]
	3.2	Automation Mechanisms: Components and logic of an Automatic conveyor belt mechanism. Control operation and speed regulation.	5	["4"]
	3.3	Industrial Applications: Robotics in industry: Logic for "Pick and Place" robots and Spot Welding automation.	5	["4"]

Module	Units	Course Description	Hrs	CO No.
4	Sequential Logic & Industrial Safety			
	4.1	Advanced Switching & Latching: Design principles of toggle logic and state-retention circuits. Theory of "Set/Reset" vs. standard latching for industrial memory.	5	["2"]
	4.2	Timer & Counter Operations: Comprehensive study of On-Delay (TON), Off-Delay (TOF), and Retentive timers. Implementation of Up/Down counters for item processing and batch control.	5	["2"]
	4.3	Sequential Functional Logic: Designing multi-stage timing sequences (e.g., Traffic Light cycles) and interlocking logic to prevent simultaneous conflicting outputs (e.g., Motor Forward/Reverse).	5	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture, Demonstration

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Quiz, In-Class discussion **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ∘ PART - A ∘ Short answer - (10 out of 12) – 10 × 2 = 20 ∘ PART - B ∘ Short Essays - (6 out of 8) – 6 × 5 = 30 ∘ PART - C ∘ Essays - (2 out of 4) – 2 × 10 = 20

References

- Textbook Rajput, R.K, Robotics and Industrial Automation, S.Chand, (2008) Clarence W. de Silva, Sensors and Actuators: Control Systems Instrumentation, CRC Press, 2015

Suggested Readings

- Frank D. Petruzella, Programmable Logic Controllers, McGraw Hill, 2022
- John W. Webb & Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Pearson Education, 2017

Affidavit

- We, D B Pampa College, Parumala and SATHYAJITH S, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, D B Pampa College, Parumala, agree to appoint a new course coordinator for the proposed Automation and Control Applications in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the

continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.

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