GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
VI – Semester

Course Title: **Power Plant Automation**
(Course Code: 4364103)

Diploma Programme in which this course is offered	Semester in which offered
Automation and Robotics Engineering	Sixth

1. RATIONALE

The field of Power Plant Automation involves the application of control systems to operate power plants efficiently and safely. This course is designed to equip students with the knowledge and skills needed to understand, install, and maintain automation systems used in various types of power plants, including thermal, nuclear, hydroelectric, and renewable energy plants.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire the following competency:

2.1 TARGETED COMPETENCY DEVELOPMENT USING THEORY

1. Identify different types of power plants (thermal, nuclear, hydro, renewable).
2. Understand the layout and components of thermal power plants.
3. Explain the working principles of boilers, turbines, condensers, and cooling towers.
4. Identify auxiliary systems like coal and ash handling, water treatment, and feedwater systems.
5. Understand the importance of control loops like deaerator, superheater, and feedwater systems.
6. Apply P&ID diagrams to represent control strategies in power plants
7. Describe the role of sensors, transmitters, and analyzers in plant monitoring and control.
8. Understand the latest trends like IoT, SCADA, and DCS in instrumentation systems
9. Analyze real-world automation systems in power plants to understand their operation and success.
10. Identify causes of failures in power plant automation and propose basic solutions.

2.2 **TARGETED COMPETENCY DEVELOPMENT USING PRACTICAL**

- Create and simulate control loops (e.g., deaerator, feedwater, superheater) using open-source tools and platforms like OpenPLC, SCADA, and Node-RED.
- Demonstrate the ability to set up and operate instrumentation systems (e.g., temperature, pressure, flow sensors) and interpret real-time data for monitoring boiler, turbine, and condenser operations.

- Configure and implement a basic SCADA system using open-source software (e.g., ScadaBR) for monitoring and controlling equipment in a thermal power plant, ensuring efficient operation and safety compliance.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to exhibit the following COs:

3.1 THEORY COURSE OUTCOMES (COs)

CO.1 Explain the Types and Layouts of Power Plants.
CO.2 Describe the Functions of Major Equipment in Thermal Power Plants
CO.3 Interpret and Analyze Control Loops in Power Plants.
CO.4 Explain Instrumentation Systems Used in Power Plants.
CO.5 Examine Case Studies on Power Plant Automation.

3.2 PRACTICAL COURSE OUTCOMES (COs)

CO.1 Design and Implement Control Systems for Power Plant Operations
CO.2 Monitor and Analyze Key Power Plant Parameters Using Instrumentation Systems
CO.3 Develop SCADA Systems for Power Plant Automation

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L*-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *-End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are thesub-components of the COs.*Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	**Study and Comparison of Power Plant Layouts**	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	• Task: Create and compare layouts of thermal, nuclear, and renewable power plants using diagramming tools (e.g., Lucidchart, AutoCAD). • Objective: Understand different power plant components and their interconnections.		
2	**Simulation of the Rankine Cycle** • Task: Simulate the Rankine cycle in a thermal power plant using open-source software (e.g., DWSIM or OpenModelica). • Objective: Analyze energy conversion efficiency.	I	02
3	**Boiler Simulation** • Task: Create a boiler control logic in an open-source environment like OpenPLC or Arduino IDE. • Objective: Automate boiler pressure and temperature control.	II	02*
4	**Design and Operation of Steam Turbine Models** • Task: Build a basic simulation of steam turbine operation using Python or MATLAB. • Objective: Analyze the relationship between steam flow, pressure, and turbine efficiency.	II	02
5	**Cooling Tower Monitoring System** • Task: Develop a monitoring system for a cooling tower using Node-RED and sensors for temperature and humidity (DHT11). • Objective: Learn to monitor critical parameters in real-time.	II	02
6	**Implementation of a Feedwater Control Loop** • Task: Implement a feedwater control loop using an Arduino or Raspberry Pi with water flow sensors. • Objective: Demonstrate control of water flow and level.	III	02
7	**Deaerator Control System** • Task: Simulate a deaerator control loop using OpenPLC and HMI software like ScadaBR. • Objective: Understand and implement pressure and temperature control in deaerators.	III	02
8	**Visualization of Control Loops** • Task: Create P&ID diagrams for key control loops using open-source tools (e.g., DIA or Draw.io). • Objective: Familiarize students with symbols and control strategies.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
9	**Integration of IoT in Power Plant Monitoring** • Task: Use an ESP32 microcontroller to collect temperature, pressure, and flow data and visualize it in real-time on a web-based dashboard (e.g., ThingSpeak). • Objective: Learn the basics of IoT and its applications in power plants.	IV	02
10	**Flue Gas Monitoring System** • Task: Simulate a flue gas analyzer using MQ sensors for CO2 or SOx/NOx and process data using Python. • Objective: Understand emission monitoring and data processing.	IV	02
11	**Configuring a SCADA System with ScadaBR** • Task: Set up an open-source SCADA system (ScadaBR) to monitor and control boiler temperature and pressure. • Objective: Gain practical experience in SCADA configuration and visualization.	IV	02
12	**Distributed Control System (DCS) Setup** • Task: Create a basic DCS simulation using MATLAB Simulink and interface it with control loops. • Objective: Understand the architecture and functionality of a DCS.	IV	02
13	**Case Study: Automation in a Thermal Power Plant** • Task: Analyze automation processes of a real thermal power plant (research/document-based) and replicate the basic automation system in OpenPLC. • Objective: Bridge theoretical knowledge with real-world applications.	V	02
14	**Simulation of Automation Failure** • Task: Simulate an instrumentation failure (e.g., faulty temperature sensor) in a boiler and analyze the system's response in ScadaBR. • Objective: Understand failure impact and troubleshoot automation systems.	V	02
15	**Renewable Energy SCADA Integration** • Task: Create a SCADA model to integrate renewable energy sources (e.g., solar panels) with a thermal power plant using Node-RED and MQTT protocol. • Objective: Learn how hybrid systems are monitored and controlled.	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
			30

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills(more may be added/deleted depending on the course)that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

iii. *Additional Open-Source Tools for SCADA Implementation*
   a. *OpenPLC: For PLC programming and simulation.*
   b. *ScadaBR: For creating SCADA systems with HMI interfaces.*
   c. *Node-RED: For IoT integration and real-time monitoring.*
   d. *DIA/Draw.io: For diagramming P&ID and layouts.*
   e. *ThingSpeak: For IoT-based data visualization.*

5.1 SAMPLE PERFORMANCE INDICATORS

S. No.	Sample Performance Indicators for the PrOs	Description	Weightage in %
1	Setup and Configuration	Ability to prepare experimental setups, connect devices, and configure software tools correctly.	20
2	Execution of Practical Tasks	Proficiency in operating equipment, running simulations, or implementing control systems	25
3	Data Recording and Analysis	Accuracy in recording measurements and interpreting results (e.g., identifying trends or errors)	20
4	Troubleshooting and Problem-Solving	Effectiveness in diagnosing and resolving system issues during practical execution.	15
5	Report Preparation and Presentation	Quality and clarity of practical reports, including diagrams, observations, and conclusions	20
	Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

Equipment Name	Broad Specifications	Practical No.
Boiler Simulation Kit	Includes pressure sensors, temperature sensors, and PID control setup; capable of simulating real-time boiler operations.	Practical 3, 11

Turbine Speed Control Trainer	A model turbine with speed control capability; includes vibration monitoring and flow sensors.	Practical 4, 13
Cooling Tower Monitoring Kit	Includes temperature and humidity sensors (DHT11/DHT22), flow meters, and basic IoT integration.	Practical 5, 9
PLC Training Kit	OpenPLC-compatible controller, digital and analog I/O modules, and relay boards for control loop simulation.	Practical 3, 6, 7
SCADA Software (Open Source)	ScadaBR or Node-RED for HMI design and real-time data acquisition and control.	Practical 11, 12, 14
IoT Microcontroller Kit	ESP32/Arduino with Wi-Fi connectivity; compatible with sensors for IoT-based monitoring.	Practical 9, 15
Sensors and Transmitters	- Temperature sensor (RTD/PT100, thermocouple) \n - Pressure sensor (strain gauge) \n - Flow sensor (ultrasonic/turbine).	Practical 8, 9, 10
Distributed Control System (DCS)	DCS simulator or software (e.g., MATLAB Simulink) for control system visualization and simulation.	Practical 12, 13
P&ID Diagram Software	Open-source diagramming tools like Draw.io, DIA, or Lucidchart for designing control system diagrams.	Practical 6, 8
Flue Gas Analyzer	Portable analyzer with capabilities to measure CO2, SOx, and NOx levels; includes data logging functionality.	Practical 10, 14
Basic Measurement Trainer Kits	Kits for flow, level, temperature, and pressure measurement, equipped with calibrators and test benches.	Practical 6, 7, 8
Vibration Analyzer	Equipment for monitoring vibration in turbines and rotating equipment; includes FFT analysis capability.	Practical 4, 12

6.1 MAPPING OF EQUIPMENT TO PRACTICALS

- **Boiler Simulation Kit**: Used for understanding control loops like feedwater and deaerator systems (Practicals 3, 11).
- **SCADA Software**: Essential for configuring and visualizing control loops and real-time monitoring (Practicals 11, 12, 14).
- **IoT Microcontroller Kit**: Helps students integrate IoT with SCADA for innovative monitoring solutions (Practicals 9, 15).
- **Flue Gas Analyzer**: Used for emission monitoring and analyzing system responses to failures (Practicals 10, 14).

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* for development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I Introduction to Power Plants	1a. Understand the classification and types of power plants (thermal, nuclear, hydroelectric, and renewable energy-based). 1b. Discuss the role of renewable energy power plants in modern energy systems 1c. Draw the general layouts and components of different power plants. 1d. Draw and explain the general layout of a thermal power plant. 1e. Compare different types of power plants and their suitability based on energy sources. 1f. Explain key components of a Thermal power plant. Briefly explain their functions. 1g. Explain the energy conversion cycle in a thermal power plant.	1.1 Overview of Power Plants 1.1a Classification of power plants: Thermal, Nuclear, Hydroelectric, and Renewable Energy-based. 1.1b Importance and role of power plants in the energy sector. 1.1c Discuss the role of renewable energy power plants in modern energy systems. 1.2 Layouts of Power Plants 1.2a Comparative layouts of nuclear, hydroelectric, and renewable energy power plants. 1.2b General layout of thermal power plants. 1.2c Energy flow and conversion processes in thermal power plants using block diagram. 1.3 Compare different types of power plants and their suitability based on energy sources. 1.4 Thermal Power Plant 1.4a Components: Boiler, Turbine, Generator, Condenser, Cooling Tower. 1.4b Rankine Cycle in thermal power plants. 1.4c Advantages and limitations of thermal power plants.

Unit – II Major Equipment of Thermal Power Plants	2a. Identify and explain the function of major equipment used in thermal power plants. 2b. Understand the working principles and significance of boilers, turbines, condensers, and cooling towers. 2c. Draw and interpret schematic diagrams of thermal power plant equipment. 2d. Explain the working of a supercritical boiler with a neat diagram. 2e. Describe the function of a steam turbine in a thermal power plant. 2f. What is the role of the condenser in a thermal power plant? Explain with a diagram. 2g. Discuss the significance of cooling towers in maintaining plant efficiency. 2h. Explain how a coal handling system operates in a thermal power plant.	2.1 Boilers and Their Types 2.1a Subcritical, Supercritical, and Ultra-supercritical boilers. 2.1b Boiler design, operation, and maintenance. 2.2 Steam Turbines / Gas Turbine 2.2a Types: Impulse and Reaction turbines. 2.2b Role of turbines in energy conversion. 2.2c Gas Turbine Operations refer (Mark VI) control GE 2.3 Condensers and Cooling Systems 2.3a Surface and jet condensers. 2.3b Types of cooling towers: Natural draft, forced draft, and induced draft. 2.4 Auxiliary Systems 2.4a Coal handling and feeding systems. 2.4b Ash handling systems. 2.4c Water treatment and feedwater systems. 2.4d DM Tank Operations
Unit– III Control Loops in Power Plants	3a. Understand the concepts of control loops and their importance in power plant operations. 3b. Explain role of the superheater control loop with its operation. 3c. Explain the control strategy for the and the control loops for deaerator, superheater, reheater, economizer, and feedwater systems. 3d. Explain Shrinking Swelling Effect – Inverse Response of the System using Boiler Level Control Loop 3e. Explain Two element Three element Boiler control loop	3.1 Introduction to Control Loops 3.1a Concept of closed-loop control. 3.1b Importance of control loops in power plant operation. 3.2 Process Diagrams and Interpretation 3.2a Understanding and interpreting P&ID diagrams. 3.2b Symbols and notations used in control loops 3.3 Key Control Loops in Thermal Power Plants 3.3a Deaerator control loop. 3.3b Feedwater control loop. 3.3c Superheater and reheater control loops. 3.3d Economizer control loop. 3.3e Turbine speed and load control

	3f. Discuss the importance of feedwater control in maintaining boiler efficiency. 3g. Interpret P&ID (Piping and Instrumentation Diagram) for control loops in power plants.	loop. 3.3f Burner Management Systems 3.3g Master Header Pressure Controller system 3.3h EDMS System for electrical load Management 3.4 Steam Drum Level Controller : Explain Two element – Three element Boiler Level Control Loop 3.5 Discuss the importance of feedwater control in maintaining boiler efficiency. 3.6 With the help of a P&ID, explain the reheater control loop in a thermal power plant. 3.7 Define the economizer control loop and explain how it optimizes fuel usage.
Unit– IV Instrumentation Systems in Power Plants	4.a Understand the latest trends and technologies in power plant instrumentation. 4.b Discuss the role of an advanced DCS in power plant automation. 4.c Explain the Need and importance of ESD at Powerplant 4.d Prepare sample Cause and Effect Matrix with Generator related tripping control 4.e Understand the role of sensors, transmitters, and analyzers in plant operations. 4.f Explain the application and importance of analyzers to monitor flue gas emissions 4.g Compare the features of different top three vendors (ABB, GE, and Siemens) instrumentation systems. 4.h Explore the integration of modern technologies like IoT and advanced control systems.	4.1 Discuss overview of Instrumentation in Power Plants 4.1a. Role of sensors, transmitters, and controllers. 4.1b. Importance of real-time monitoring systems. 4.2 Latest Trends in Instrumentation 4.2a. Distributed Control Systems (DCS). 4.2b. Emergency Shutdown System (ESD) – Cause and Effect Matrix with Generator related tripping controls 4.2c. Internet of Things (IoT) in power plants. 4.3 Advanced Measurement Systems 4.3a Flue gas analyzers and emission monitoring systems. 4.3b Vibration monitoring for turbines. 4.3c Temperature, pressure, and flow measurement technologies. 4.4 Instrumentation Systems by Industry Leaders 4.4a Overview of ABB, GE, and Siemens technologies. 4.4b Case examples of implementation in power plants. 4.4c Compare the features of ABB, GE, and Siemens instrumentation systems.

		4.5 Explain the role of IoT in modern power plant operations.
Unit– V Case Studies	5.a Discuss real-world examples of power plant automation. 5.b Investigate causes of automation failures and propose solutions. 5.c Explain a case where instrumentation upgrades significantly improved power plant performance 5.d Explain the challenges faced in integrating renewable energy systems into conventional power plants. 5.e Role of AI and machine learning in predictive maintenance.	5.1 Present a case study on a thermal power plant's automation system and discuss its success factors. 5.2 Analyse a failure incident in power plant automation and suggest improvements. 5.2a Analysis of incidents caused by instrumentation or automation failures. 5.2b Root cause analysis and corrective measures. 5.3 A case study: instrumentation upgrades significantly improved power plant performance. 5.3a Case studies on performance improvement through upgraded instrumentation. 5.3b Reduction in emissions and compliance with environmental standards 5.4 Explain the challenges faced in integrating renewable energy systems into conventional power plants. 5.5 Role of AI and machine learning in predictive maintenance.

***Note**:The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction to Power Plants	09	5	5	4	14
II	Major Equipment of Thermal Power Plants	07	4	5	5	14
III	Control Loops in Power Plants	09	4	5	5	14
IV	Instrumentation Systems in Power Plants	09	4	4	6	14
V	Case Studies	08	4	4	6	14
Total		42	**21**	**23**	**26**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of theUOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varyslightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare specification of some Industrial measuring devices related to Powerplant.
b) Undertake micro-projects in teams: Visit to Powerplant
c) Give seminar on any relevant topic.
d) Undertake a market survey of different Industrial Thermal Powerplant components.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assess educing different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environ and sustainability
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs.Similar micro-projects could be added by the concerned course teacher:

a) **Industrial Hazard**: Compile a report of past industrial massive accidents, their causes, effects, and strategies used and suggested to prevent such incidents.
B) Model making of some innovative Powerplant
c) Real IoT mini project set up / Renewable Power plant Setup / Model.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with Place, Year, and ISBN
1	Power Plant Engineering	Domkundwar, Arora	Dhanpat Rai & Co., India, 2020, ISBN: 978-81-7700-483-1
2	Power Plant Instrumentation and Control Handbook	Philip Kiameh	Elsevier, USA, 2014, ISBN: 978-0-12-391855-8
3	Instrumentation for Process Measurement and Control	Norman A. Anderson	CRC Press, USA, 2017, ISBN: 978-1-138-74168-6
4	Introduction to SCADA and PLCs	David Bailey, Edwin Wright	Elsevier, UK, 2003, ISBN: 978-0-7506-5796-5
5	Modern Power Station Practice	British Electricity International	Butterworth-Heinemann, UK, 1990, ISBN: 978-0-408-01566-5
6	Power Plant Engineering	P.K. Nag	McGraw Hill Education, India, 2017, ISBN: 978-0-07-068113-2
7	Industrial Instrumentation	Donald P. Eckman	Wiley Eastern, India, 1990, ISBN: 978-81-224-0778-4
8	Control of Power Plants and Power Systems	Allan Wood	Springer, USA, 1994, ISBN: 978-1-4612-8494-3
9	Practical Power Plant Engineering	Zark Bedalov	Wiley, USA, 2020, ISBN: 978-1-119-58362-0
10	Distributed Control Systems	Michael P. Lucas	Van Nostrand Reinhold, USA, 1990, ISBN: 978-0-442-01207-2
11	Instrumentation Engineers Handbook (Vol. 1 & 2)	Bela G. Liptak	CRC Press, USA, 2016, ISBN: 978-1-4822-6276-0 (Vol. 1)

14. SOFTWARE/LEARNING WEBSITES

14.1 SOFTWARES

1. **OpenPLC**
    - A free, open-source platform for PLC programming.
    - Use for creating control systems for power plants and simulating automation tasks.
    - Website
2. **ScadaBR**
    - Open-source SCADA software for monitoring and control applications.
    - Ideal for creating small-scale SCADA systems for learning purposes.
    - Website
3. **DWSIM**
    - Open-source chemical process simulator.
    - Can be used to simulate power plant processes like the Rankine cycle.
    - Website

4. **MATLAB/Simulink**
    - For simulating control systems, DCS architecture, and power plant processes.
    - Offers advanced modeling and real-time simulation capabilities.
    - Website
5. **Node-RED**
    - A flow-based programming tool for IoT integration.
    - Use to connect IoT devices and visualize power plant data.
    - Website
6. **ThingSpeak**
    - An open-source IoT platform for data collection and visualization.
    - Suitable for monitoring and analyzing plant data.
    - Website
7. **AutoCAD Plant 3D**
    - For creating P&ID diagrams and layouts for power plant systems.
    - Industry-standard for engineering design and drafting.
    - Website
8. **KEPServerEX**
    - An OPC server platform for SCADA integration.
    - Useful for connecting field devices with SCADA/DCS systems.

14.2 LEARNING WEBSITES

1. **ABB Power Plant Automation Solutions**
    - Learn about modern power plant automation systems and instrumentation solutions.
2. **Siemens Power Plant Automation**
    - Offers detailed insights into SCADA, DCS, and safety systems for power plants.
3. **GE Grid Solutions**
    - Explore advanced automation technologies for grid and power plant operations.
    - Website
4. **YouTube Channels**
    - **NPTEL (National Programme on Technology Enhanced Learning):** Lectures on instrumentation and automation.
      YouTube Channel
    - **RealPars:** Tutorials on PLC, SCADA, and automation systems.
      YouTube Channel
5. **Instrumentation Tools**
    - A comprehensive platform for learning instrumentation and control systems.
    - Website
6. **Coursera and edX**
    - Online courses on SCADA, PLC programming, and industrial automation by top universities.
    - Coursera

   - [edX]
7. **ISA (International Society of Automation)**
   - Offers technical resources and certifications in industrial automation.
   - [Website]
8. **PLC Academy**
   - Learn about PLC programming, SCADA, and industrial automation concepts.
   - [Website]

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Prof Urvish Soni	**Government Polytechnic Ahmedabad**	**9428532878**	**upsoni@gpahmedabad.ac.in**
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