GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Instrumentation and Control Engineering / Automation & Robotics

Subject Code : DI04000231

Subject Name : Automation Solution

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	MOPEC

Prerequisite:	Basic Engineering Knowledge, Mathematics & Physics, Control Systems & Automation Basics
Rationale:	Smart Building Automation Systems (BAS) maintain temperature within a set range, schedule lighting based on occupancy, monitor system performance, detect device failures, and issue fault alerts. Compared to non-automated buildings, automation reduces energy consumption and maintenance costs. A Building Management System (BMS), comprising hardware and software, integrates and controls the entire MEP (Mechanical, Electrical, and Plumbing) and security infrastructure of a building. Through this course, students will gain a comprehensive understanding of automation across fire safety, HVAC, electrical power, and access control systems, while also learning relevant international standards. This prepares them to design, implement, and manage efficient, sustainable, and secure smart buildings.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Describe the basic concepts, structure, and subsystems of building automation systems.	U
2	Demonstrate the use of automation in fire safety systems such as alarms, detectors, and panels.	A
3	Identify components of HVAC systems and explain how automation improves comfort and efficiency.	U
4	Illustrate how electrical power management systems (lighting, sensors, relay panels) save energy in buildings.	A
5	Explain and set up basic access control systems using CCTV, card readers, and IP-based devices.	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
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	0	3	70	30	0	0	100

Course Content

Unit	Topics and Sub-topics	No. Of Hrs.	% Weightage
Unit – I Fundamentals of Building Automation	1.1. Introduction to Automation 1.1.1. Definition, scope, applications in buildings 1.2. Physical Processes 1.2.1. Mechanical, electrical, thermal processes 1.3. Localized vs. Distributed Processes 1.3.1. Examples in building systems 1.4. Process Behavior & Management 1.4.1. Response characteristics, monitoring, optimization 1.5. Process Signals 1.5.1. Analog vs. digital, discrete vs. continuous 1.6. Automation Steps 1.6.1. Sensing → Processing → Actuation → Feedback 1.7. Needs & Benefits of Automation 1.7.1. Safety, efficiency, reliability, cost savings 1.8. Automation System Structure 1.8.1. Overall architecture, subsystems overview 1.9. Subsystems in Automation 1.9.1. Input instrumentation (sensors) 1.9.2. Output instrumentation (actuators) 1.9.3. Human interface (panels, displays) 1.9.4. Control subsystem (controllers, PLCs, microprocessors)	10	20

Unit – II Fire Safety Automation	2.1. Fire Services & Installations 2.1.1. Types of fire services in buildings 2.2. Fire Alarm & Detection Systems 2.2.1. Smoke detectors, heat detectors, flame detectors 2.3. Suppression Systems 2.3.1. Sprinklers, hose reels, hydrants, foam systems 2.4. Microprocessor-based Fire Alarm Systems 2.4.1. Control panels, annunciator panels 2.5. Fire Detection & Notification Devices 2.5.1. IP paging, mass notification systems 2.6. Fire Standards 2.6.1. NFPA, BS, IS codes, design procedures	08	20
Unit – III HVAC Automation and Energy Efficiency	3.1. Human Comfort & Need for Air-conditioning 3.1.1. Thermal comfort, humidity, ventilation 3.2. Classification of Air-conditioning Subsystems 3.2.1. Comfort vs. industrial air-conditioning 3.3. HVAC Components 3.3.1. Boilers, chillers, air-handling units, terminal units 3.4. Efficiency in HVAC Systems 3.4.1. Load reduction, equipment sizing 3.5. Strategies for Maximizing Efficiency 3.5.1. Energy-saving methods, smart controls 3.6. HVAC Sequence of Operation 3.6.1. Typical operation cycle 3.7. Maintenance of HVAC Systems 3.7.1. Preventive and corrective maintenance 3.8. Displacement Ventilation 3.8.1. Concept and applications 3.9. HVAC Controls 3.9.1. Field-level controllers, system-level controllers	10	20
Unit – IV Electrical Power and Energy Management Automation	4.1. Terminologies in Electrical Power Engineering 4.1.1. Voltage, current, power factor, harmonics 4.2. Power Transmission & Distribution in Buildings 4.2.1. From grid to building systems 4.3. Power Systems & Power Quality 4.3.1. Measurement, monitoring, improvement methods 4.4. Lighting Systems in Buildings 4.4.1. Types of lighting, automation in lighting 4.5. Lighting Control Systems	9	20

	4.5.1. Dimmers, timers, occupancy sensors 4.6. Relay Panels & System Control 4.6.1. Basics of relay operation and control panels 4.7. Energy Management Concepts 4.7.1. Energy savings, building efficiency improvement 4.8. Green Building Concepts 4.8.1. LEED certification, ASHRAE standards		
Unit – V Access Control and Security Automation	5.1. Access Control Systems 5.1.1. Purpose, components, design basics 5.2. CCTV Systems 5.2.1. Cameras (types, operation), lenses, cables 5.3. Control Panels & Servers 5.3.1. Host computers, peripheral devices 5.4. Sensors for Access Control 5.4.1. Door contacts, request-to-exit devices 5.5. Electrified Door Hardware 5.5.1. Locks, card readers, biometric devices 5.6. IP & POE-based Access Control Systems 5.6.1. Benefits, power issues 5.7. People Counters & Other Devices 5.7.1. Applications in monitoring and analytics	8	20
	Total	**45**	**100**

AFFECTIVE DOMAIN OUTCOMES

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

a) Develop appreciation for the role of automation in modern buildings.
b) Value the importance of safety standards (NFPA, IS codes) and ethical responsibility in protecting lives.
c) Show concern for human comfort and energy conservation in building systems.
d) Appreciate sustainable practices, energy efficiency, and green building concepts.
e) Recognize the ethical and social importance of security, privacy, and controlled access in buildings.

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:

Unit 1: Fundamentals of Building Automation
- Prepare a flowchart showing automation steps (sensing → processing → actuation → feedback).
- Collect examples of automation subsystems (sensors, actuators, controllers) from real buildings.
- Group discussion: *"Why automation is essential in modern buildings?"*

Unit 2: Fire Safety Automation
- Case study: Analyze a recent fire incident and suggest how automation could have reduced damage.
- Prepare a poster showing types of fire detectors and suppression systems.
- Debate: *"Is automation more reliable than human intervention in fire safety?"*

Unit 3: HVAC Automation and Energy Efficiency
- Prepare a chart of HVAC components (boilers, chillers, AHUs, terminal units).
- Survey: Collect data on comfort parameters (temperature, humidity) in classrooms and suggest improvements.
- Assignment: *"Strategies for maximizing HVAC efficiency in a college building."*

Unit 4: Electrical Power and Energy Management Automation
- Prepare a report on energy consumption in your institute and suggest automation solutions.
- Draw a block diagram of lighting control systems with occupancy sensors.
- Group activity: *"Green building concepts and their relevance in India."*

Unit 5: Access Control and Security Automation
- Prepare a presentation on CCTV system components (cameras, lenses, cables).
- Role play: Demonstrate how access control systems (card readers, door contacts) work in a building.
- Assignment: *"Ethical issues in surveillance and access control."*

SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Following Sample strategies teacher can use to accelerate the attainment of the various outcomes in this course:

- Case-based teaching – Use real building examples (airports, hospitals, campuses) to explain automation applications.
- Visualization tools – Show videos, diagrams, or animations of BAS subsystems (HVAC plants, fire panels, CCTV).
- Standards integration – Introduce NFPA, ASHRAE, IS codes through assignments and short discussions.
- Collaborative learning – Group discussions, peer presentations, and debates on safety, sustainability, and ethics.
- Mini paper-projects – Students design simple automation plans (classroom fire alarm layout, energy-efficient HVAC scheme)

SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Overview of Industrial Process Automation, 2nd Edition	KLS Sharma	Elsevier, Netherlands, ISBN: 978-0-12-805354-6
2	INTELLIGENT BUILDING SYSTEMS	Albert Ting-pat So, WaiLokChan	SPRINGER SCIENCE+BUSINESS MEDIA, LLC, 1999, ISBN 978-1-4613-7280-6
3	Smart Building Systems for Architects, Owners, and Builders	James Sinopoli	Elsevier, Netherlands, ISBN: 978-1-85617-653-8
4	Design of Special Hazards and Fire Alarm Systems	Robert Gagnon	Thomson Delmar Learning; 2nd edition, 2007
5	Process Control- Instrument Engineers Handbook	Bela G. Liptak,	Chilton book co.

SUGGESTED LEARNING WEBSITES

Unit 1: Fundamentals of Building Automation

- https://nptel.ac.in/courses/108105017
- https://www.allaboutcircuits.com/

- https://www.open.edu/openlearn/science-maths-technology/smart-cities/content-section-overview

Unit 2: Fire Safety Automation

- https://www.nfpa.org/Codes-and-Standards/Free-access
- https://www.osha.gov/fire-safety
- https://gidm.gujarat.gov.in/

Unit 3: HVAC Automation and Energy Efficiency

- https://nptel.ac.in/courses/112106138
- https://energyeducation.ca/encyclopedia/HVAC
- https://www.ashrae.org/technical-resources/free-resources

Unit 4: Electrical Power and Energy Management Automation

- https://nptel.ac.in/courses/108105104
- https://beeindia.gov.in/
- https://www.electrical4u.com/

Unit 5: Access Control and Security Automation

- https://ipvm.com/free
- https://www.geeksforgeeks.org/computer-network-security/
- https://www.classcentral.com/subject/access-control-systems

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