GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2023)

Semester-VI

Course Title: Automation Solution

(Course Code: 4361708)

Diploma programme in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	Sixth

1. RATIONALE

Maintaining the temperature within a predetermined range, lighting the rooms according to an occupancy schedule, keeping an eye on system performance and device failures, and issuing fault alerts are all functions of the Smart Building Automation System. When compared to a non-controlled building, automation technologies lower building energy and maintenance expenses. The entire MEP (Mechanical, Electrical, and Plumbing) and security structure of a building are controlled and monitored by the Building Management System, a computer-based control system implemented in the building. Hardware and software are both parts of a BMS. Students who take this course will be better able to comprehend the numerous facets of the various systems found in well-organized buildings.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

   a) Gain knowledge about various types of automation required in building

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 display the following COs:

a) Describe different types of automation and processes
b) Analyze working of fire safety systems and describe its standards
c) Analyze working of HVAC systems
d) Analyze working of electric power system and implement light control systems
e) Analyze working of access control systems and implement it.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+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 the subcomponents 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'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Classify process and explain difference between localized and distributed processes	1	2
2	Understand structure automation systems and explain different sub systems associated with it	1	2
3	Implement smoke detection systems using sensor and any uc/ Simulation software	2	4
4	Implement fire detection alarm system using sensor and any uc/ Simulation software	2	4
5	Case study of Fire Standards	2	2
6	Detect presence of human and turn on fan using sensor and any uc/ Simulation software	3	4
7	Case study of HVAC system implemented in mall	3	2
8	Design automatic street light controller using sensor and transistor/ Simulation software	4	4
9	Prepare chart of ASHRAE Symbols	4	2
10	Case study of power transmission system	4	2
11	Understand the structure of CCTV camera and different types of lenses	5	2
12	Implement a up counter / up-down counter using sensor and any uc/ Simulation software	5	4
13	Case study of IP based access control system	5	2
14	Case study of people counter implemented in mall	5	2
		Total	**38**

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.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup/simulation circuit	20
2	Operate the equipment setup or execute simulation circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
	Total	**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

1.   Computer System.
2.   Simulation Software.

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 safety practices while using electrical appliances.
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:

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit 1 Basics of Automation Systems	1. Classification of physical processes 2. Explain various process aspects 3. Explain Steps for Automation 4. Explain Needs and benefits of automation 5. Explain structure of automation system	1.1 Introduction 1.2 Physical Processes 1.3 Localized and Distributed Processes 1.4 Process Behavior 1.5 Process Management 1.6 Process Signals 1.7 Automation Steps 1.8 Needs met by Automation 1.9 Benefits of Automation 1.10 Automation System Structure 1.11 Subsystems 1.12 Input Instrumentation Subsystem 1.13 Output Instrumentation Subsystem 1.14 Human Interface Subsystem 1.15 Control Subsystem
Unit 2 Automation for Fire Safety	1. Explain types of Fire services 2. Explain use of fire alarm and detection 3. Explain need of different fire safety equipments 4. Explain use of uP based fire alarm detection 5. Explain role of annuncialtor panel in fire safety 6. Explain fire hazard can be communicated 7. Explain different fire standards	2.1 Introduction 2.2 Types of Fire Services Installation 2.3 Automatic Fire Alarm and Detection 2.4 Sprinklers 2.5 Hose Reels and Hydrants 2.6 Foam Systems 2.7 Microprocessor Based Fire Alarm Systems 2.8 Fire Alarm Control Panel 2.9 Annunciator Panel 2.10 Fire Detection and Suppression Systems 2.11 Notification Devices 2.12 Monitoring 2.13 Communications and IP 2.14 Mass Notification Systems 2.15 IP Paging Systems 2.16 Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, IS Concept of IP enabled fire & alarm system, design aspects and components of PA system

| Unit 3 Automation for HVAC systems | 1. Explain need of human comfort and use of Air conditioning
2. Classify air-conditioning sub systems
3. Explain use of air conditioning systems and their components
4. Explain operation of air handling and terminal units
5. Explain importance of efficiency and strategies to increase efficiency
6. Explain HVAC sequence of operation and maintenance of HVAC systems
7. Explain displacement ventilation and HVAC Controls | 3.1 Introduction
3.2 Human Comfort
3.3 Comfort Air-conditioning
3.4 Classification of Air-conditioning Sub-systems
3.5 Air-conditioning Systems
3.6 Components
3.7 Boilers
3.8 Chillers
3.9 Air-Handling Units
3.10   Air Terminal Units
3.11   Efficiency
3.12   Strategies for Maximizing HVAC Efficiency
3.13   Reducing Loads
3.14   Equipment Sizing
3.15   HVAC Sequence of Operation
3.16   Maintenance
3.17   Displacement Ventilation
3.18   HVAC Controls
3.19   Management Level
3.20   System-Level or Building-Level Controllers
3.21   Field-Level Controllers |
| Unit 4 Automation for Electrical power management | 1. Explain different terminologies associated with electrical power engineering
2. Explain how electric power is transmitted to buildings
3. Explain how power systems are working and quality of power is measured
4. Explain role of systems control and relay panels
5. Explain how occupancy sensors can save power
6. Learn different ASHRAE symbols
7. Explain need of energy management and how it can be implemented | 4.1 Introduction
4.2 Terminologies in Electrical Power Engineering
4.3 Electric Power Transmission to Buildings
4.4 Electric Power Systems in Buildings
4.5 Electric Power Quality in Buildings
4.6 Lighting Systems in Buildings
4.7 Lighting Control Systems
4.8 System Control
4.9 Relay Panels
4.10   Occupancy Sensors
4.11   ASHRAE Symbols
4.12   Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples. |

Unit 5 Automation for Access Control	1. Explain what is access control systems and different components 2. Learn the structure of CCTV and different types of lenses and cables. 3. Learn different types of sensors can be used for access control 4. Explain how IP based access control can be established 5. Learn how people counter and other devices can be used for access control.	5.1 Access Control Systems 5.2 Access Components, Access control system Design. CCTV: Camera: Operation & types, Components of CCTV system like cameras, types of lenses, typical types of cables, 5.3 Server or Host Computer 5.4 Control Panels 5.5 Peripheral Devices 5.6 Door Contacts 5.7 Request-to-Exit 5.8 Electrified Door Hardware 5.9 Card Readers 5.10 IP POE-Powered Access Control Systems 5.11 POE Power Issues 5.12 IP and POE Benefits 5.13 People Counters 5.14 Devices

a)   SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN: NA

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Basics of Automation Systems**	4	4	4	0	8
II	**Automation for Fire Safety**	10	8	6	3	17
III	**Automation for HVAC systems**	10	8	6	3	17
IV	**Automation for Electrical Power Management**	10	8	6	3	17
V	**Automation for Access Control**	6	5	4	2	11
		40	**33**	**26**	**11**	**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 vary slightly from above table.

b)   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:

i. Industrial visit should be arranged by department for students so that students can have exposure to the real industrial realm.

ii. Department should arrange a workshop/seminar where students can have interaction with industry personnel.

c)   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)
   a) Encourage students to perform experiments in groups of maximum 3 students
   b) Ask students to observe different types of automation systems implemented in public places like mall, theater etc.
   c) Show some videos/animation of related to automation systems.

12.   SUGGESTED PROJECT LIST

NA

13.   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.

14.   SOFTWARE/LEARNING WEBSITES

a) Keil
b) Proteus
c) Arduino IDE
d) https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-building-automation.html
e) https://www.se.com/us/en/work/products/building-automation-and-control/
f) https://www.johnsoncontrols.com/building-automation-and-controls
g) https://www.isa.org/training/course-description/ea15

15.   PO-COMPETENCY-CO MAPPING:

Semester VI	Automation Solution (Course Code - 4361708)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experiment-ation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	**Design, Implement and troubleshoot different types of automation solution**						
Describe different types of automation and processes	3	3					1
Analyze working of fire safety	3	3	2	1	1		3

systems and describe its standards						
Analyze working of HVAC systems	3	3	2	1	1	3
Analyze working of electric power system and implement light control systems	3	3	2	1	1	3
Analyze working of access control systems and implement it	3	3	2	1	1	3

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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