GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151711
Semester – V
Subject Name: BULDING AUTOMATION

Type of course: Open Elective

Prerequisite: Fundamental of sensors, Control, Fire and Safety

Rationale: The Building Automation System (BAS) core functionality is to keep building climate within a specified range, light rooms based on an occupancy schedule, monitor performance and device failures in all systems and provide malfunction alarms. Automation systems reduce building energy and maintenance costs compared to a non-controlled building. Building Management System is computer-based control system installed in building that controls and monitors the total MEP (Mechanical – Electrical – Plumbing) and security Structure. BMS consist of both Hardware and software. This subject will help the students to understand the various aspects of different systems seen in well-structured building

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

S. N.	Content	Total Hrs
1	**Introduction** Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.	02
2	**Fire Alarm System** Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation. FAS Components: Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples. FAS loops: Classification of loops, Examples. 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.	04

3	**Access Control System:** Access Components, Access control system Design. **CCTV:** Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. **CCTV Applications:** CCTV Applications.	04
4	**Security Systems** **Fundamentals:** Introduction to Security Systems, Concepts. **Perimeter Intrusion:** Concept, Components, Technology, Advanced Applications. Security Design: Security system design for verticals. Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.	04
5	**HVAC system** **Fundamentals:** Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating ,Cooling etc) **Human Comfort:** Human comfort zones, Effect of Heat, Humidity, Heat loss. **Processes:** Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, and Exhaust Fans), Unitary Systems (VAV, FCU etc).	04
6	**Energy Management System:** **ASHRAE** Symbols **Energy Management:** Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.	04
7	**Building Management System:** IBMS (HVAC, Fire & Security) project cycle, Project steps BMS. Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS	02

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**14**	**14**	**14**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub. by R.S. Means Company, 1991.
3. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.
4. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition, 2007.
5. HVAC Controls and Systems by Levenhagen, John I.Spethmann, Donald H., McGraw-HillPub.
6. HVAC Control in the New Millennium by Hordeski, Michael F, Fairmont press, 2001.
7. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co.

Course Outcome:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand and analyze current philosophy, technology, terminology, and practices used in building automation	30
CO-2	Interpret different safety and security standards for building management system	20
CO-3	Investigate various hardware and software requirement for given HVAC system	15
CO-4	Evaluate energy management and communication for efficient Building Management System	15
CO-5	Identify various tools and techniques in BMS for Design of Secure, Safe and Green building	20

Suggested List of Experiments:

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Sr. No.	Name of Experiment
1.	To Draw different ASHRAE symbols.
2.	To perform Illumination Control with different circuits.
3.	To develop an Automatic Overhead Tank Filling System
4.	To study about Heating Ventilation & Air-Condition System (HVAC).
5.	To study about Closed Circuit Television (CCTV).
6.	To study & perform Fire Detector & Fire Alarm System.
7.	To Develop a VI screen for monitoring alarm annunciator system using LabVIEW.
8.	To Elaborate concept of Green building in automation context.
9.	To create an application for building automation.
10.	To Evaluate solutions for building management system provided by various companies.

Project/Assignments/others

1. Draw architecture of HVAC system, BMS system
2. Elaborate concept of Green building in automation context
3. Evaluate solutions for building management system provided by various companies
4. Develop PLC Ladder for 3 floor lift control with diagram
5. Develop automatic street lighting control using LDR.

Through practical, following aspects related with building automation can be demonstrated.

1. Illumination (lighting) control
2. Electric power control
3. Heating, Ventilation and Air-conditioning (HVAC)
4. Security and observation
5. Access control
6. Fire detector (Ionization, optical, heat, beam, smoke) & alarm system
7. Lifts, elevators etc.
8. Biometric system
9. Closed-circuit television (CCTV)
10. Control Panel
11. Alarm Monitor
12. Security Automation

Design based Problems (DP)/Open Ended Problem:

- ☐ Draw architecture of HVAC system, BMS system.
- ☐ Elaborate concept of Green building in automation context.

☐ Evaluate solutions for building management system provided by various companies

Major Equipment:

Computers, I/O modules, PLC, SCADA software, DCS set up, HVAC set up, fire detector sensors, RFIDdetector, Proximity sensors, Face and Voice detection system, Biometric system, etc.

List of Open Source Software/learning website:

http://nptel.ac.in/video.php

https://buildingsolutions.honeywell.com/en-

US/Pages/default.aspx http://www.isa.org

http://www.controleng.com/

http://www.schneider-electric.com/b2b/en/solutions/system/s1/buildings-systems.jsp

http://www.automation.siemens.com/

http://coep.vlab.co.in/?sub=33&brch=97