

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: INSTRUMENTATION & CONTROL ENGINEERING (17)

SUBJECT NAME: BUILDING AUTOMATION

SUBJECT CODE: 2171713

B.E. 7th SEMESTER

Type of course: Core Engineering

Prerequisite: Sensor/ transducer, field transmitters, converters, final control element, basic instrumentation symbols, process control modes and techniques, PLC architecture

Rationale: Security of the building and safety of personal are becoming important aspects now a day and in near future, it will be in a great demand. Complex infrastructure requires a variety of building automation and control Systems. 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:

TeachingScheme			Credits C	Examination Marks						Total Marks
L	T	P		TheoryMarks			PracticalMarks			
				ESE (E)	PA(M)		ESE (V)		PA (I)	
			PA		ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

Content:

S. N.	Content	Total Hrs	% Weight age
1	<p>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.</p>	04	8
2	<p>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.</p>	06	12
3	<p>Access control System</p>	06	12

	<p>Access Control System: Access Components, Access control system Design.</p> <p>CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design.</p> <p>Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system.</p> <p>CCTV Applications: CCTV Applications.</p>		
4	<p>Security Systems</p> <p>Fundamentals: Introduction to Security Systems, Concepts.</p> <p>Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security Design: Security system design for verticals.</p> <p>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.</p>	06	12
5	<p>HVAC system</p> <p>Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating ,Cooling etc)</p> <p>Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples.</p> <p>Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss.</p> <p>Processes: Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).</p> <p>Control Theory: Instrumentation Basics, Field components & use, DDC & applications.</p> <p>Control Panel: HVAC Control Panel, MCC Basics, Panel Components</p> <p>Communication: Communication Basics, Networks, BACNet, Modbus , LON</p>	12	23
6	<p>Energy Management System:</p> <p>ASHRAE Symbols</p> <p>Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.</p>	6	12
7	<p>Building Management System:</p> <p>IBMS (HVAC, Fire & Security) project cycle, Project steps BMS.</p> <p>Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS</p>	6	12
8	<p>EPBX System :</p> <p>Design consideration of EPBX system and its components, integration of all the above systems to design BMS.</p>	6	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	7	21	21	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-Hill Pub.
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:

CO1 analyze current philosophy, technology, terminology, and practices used in building automation

CO2 evaluate different fire standards, FAS Components, FAS loops, Architectures.

CO3 select hardware and software for HVAC system

CO4 evaluate energy management system

List of Experiments:

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. PA system
12. Alarm Monitor
13. 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, RFID detector, 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>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.