GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering
Subject Code: 3164015
Semester – VI
Subject Name: Design of Electrical and Mechanical Systems for Building

Type of course: Professional Elective Course

Prerequisite: Infrastructure Utilities

Rationale: Design of Electrical and Mechanical Systems for building is used to establish the general guidelines for sizing and designing the adequate utilities according to type of building. With the help of this knowledge students may be able to:

1. Understand the needs of different utilities/systems in civil infrastructure
2. Sizing and designing adequate electrical and mechanical utilities according to building type
3. To be Familiar about economic aspects and overall safety for different system used in buildings

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction of Building Services:** Energy distribution, Energy supply (gas, electricity and renewable sources such as solar, wind, geothermal and biomass), Escalators and lifts, Facade engineering (such as building shading requirements), Fire safety, detection and protection, Heating, ventilation and air conditioning (HVAC), Information and communications technology (ICT) networks, Lighting (natural and artificial), Lightning protection, Refrigeration, Security and alarm systems, Water, drainage and plumbing	6
2	**Psychrometric and Building Cooling and Heating Load Analysis:** Thermal Comfort, Psychrometry, Properties of Moist air, Psychrometric properties and Processes for various region, Space heat gain, Space Cooling load, Cooling load general design guidelines for buildings **Sizing and Design of Air-Conditioning system for Buildings/Industrial premises:** Air conditioning systems and applications, System Selection based on building requirement, Economic Evaluation **Mechanical Ventilation of Buildings:** Indoor Air Quality, Natural Ventilation vs. Infiltration, Air Distribution patters, Duct System types for buildings, Basic principles of Air flow in Ducts, Duct sizing, Duct deign methods,	15
3	**Electrical Safety Management** : Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure -Building installation, Domestic appliances, Location of lightening arrester with reasons	11

	Protective Elements : Fuse, MCB, ELCB **Electric supply system**: Electric Services for Multi-storied Buildings Generator, UPS, Conductors, Insulations, Sub-station Layout Electric Solar panel installation, Micro grid, House wiring design, Green building, Smart metering	
4	**Electrical Lighting, Cooling and Heating systems** : **Illumination**: Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Different type of lamps, General ideas bout street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc., LED **Cooling**: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, Description of Electrical circuit used in refrigerator, air conditioner and water cooler **Heating**: Advantages of electrical heating, Heating methods	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**15**	**15**	**10**

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

Reference Books:

1. Ahmadul Ameen, Refrigeration and Air Conditioning, Publisher: Prentice-hall of India
2. Walter T. Grondzik, Alison G. Kwok, Mechanical and Electrical Equipment for Buildings, Publisher: John Wiley & Sons.
3. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delh
4. S. Sivanagaruju, "Generation and Utilization of Electrical Energy", Pearson
5. H.Partap, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai & Sons
6. J. B.Gupta, "Utilization of Electrical Energy", Kataria Publications

Course Outcomes: After studying this subject, students will be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Know and understand the different mechanical utilities and systems for the building	15
CO-2	Sizing and designing adequate mechanical utilities in civil infrastructure	35
CO-3	Know various electrical utility requirements in Building	30
CO-4	Understand about electrical safety	20

List of Experiments :

- Measurement of Earth resistance by use of Earth Tester by three -point method or fall potential test
- Measurement of Soil resistivity for domestic and commercial load.
- To observe short circuit and open circuit analysis (Winding, Cables and Wiring) on the body of electrical equipment
- Temperature controlled Alarm system (using 2 NTC)
- Model development of house wiring
- Water level control circuit
- Home Automation and protection system using IOT
- Experimental validation of IV curve for series and parallel connected PV modules
- Cooling load calculations for various types buildings.
- Sizing and designing of cooling system for the building
- Sizing and designing of air distribution duct

List of Tutorials

- Study on various mechanical systems for residential and commercial buildings
- Study of fire-fighting systems requirement according to building types
- Different types of ventilation system used for commercial buildings
- Advanced mechanical appendages to large scale commercial projects
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Major Equipments:

- Megger: Insulation Tester
- Earth resistance tester
- Relay (5v)
- Heater (resistive in nature)
- NTC thermistor 10k
- Potentiometer (10k)
- MCB
- ELCB
- Aurdino/uno
- Motion detector Sensor
- Relays for connecting home appliances,
- Electromechanically controlled doors or windows,
- PV cell
- POT Meter

List of Open Source Software/learning website: www.nptel.iitm.ac.in/courses/