GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

Mechanical Engineering (Cryogenic Engineering)

Subject Name RADIANT HEATING & COOLING SYSTEM

Sr.No	Course content
1.	INTRODUCTION TO RADIANT SYSTEMS-- Radiant phenomenon, Natural thermal environment, Application of Natural principals
2.	ADVANTAGES OF USING RADIANT SYSTEMS-- Occupant thermal comfort, radiant characteristics and applications, radiant energy and operating cost,
3.	THE ENERGY BALANCE---Concept of control volume and associated thermodynamic principles, internal energy and enthalpy, conservation of energy equation. Transient conduction in soil and Newton's law of cooling.
4.	RADIATION HEAT TRANSFER---Wavelengths and electromagnetic spectrum of radiations, absolute temperature scales. Radiative intensity, the basic building block of radiative heat transfer, and its application in the built environment. Planck's law, blackbody radiation, Wien's displacement law, Stefan-Boltzmann equation. emissivity, absorptivity, and transmissivity characteristics building material surfaces in a radiant environment. Thermophysical properties of matter encountered in the built environment. View factor calculations, Radiative resistance network approach, radiant heating systems, spherical harmonics method, Monte Carlo method, and discrete ordinates modeling.
5.	THERMAL COMFORT AND THERMAL COMFORT MODELS --Concept of Thermal Comfort, and it looks at the effects of thermal distribution systems. The Rohles-Nevin studies, the Fanger and Gagge models, and improvements to the Fanger and Gagge models. Thermal comfort design methodology, concept of The Mean Radiant Temperature, the performance capabilities of radiant heating and cooling systems in comparison to convection. Concept of The Operative Temperature., thermal comfort, measurement techniques, calculations and procedures for thermal comfort calculations.
6.	RADIANT HEATING SYSTEMS --Electric radiant heating panels, high temperature heaters radiant hydronic heating systems, Radiant Heating and Cooling Hybrid Systems, Convective Systems with Radiant Panels, optimization of system combination. Ventilation with Radiant Heating and Cooling systems.

7.	CONTROLS FOR RADIANT HEATING AND COOLING SYSTEMS--A low- or line voltage thermostat, single low-voltage control, over-temperature limit sensor or temperature control, supportive flow and temperature control sensors and valves that interact in response to the master control. Slave or independent area controls zone control, outdoor reset control, interior controls, motorized mixing valves, safety controls, downstream flow control, and temperature valves of mechanical and electronic equipments.

List of Experiments:

1. Study of different thermal comfort models and practice.
2. Determination of mean radiant temperature for the given built environment.
3. Study of different sizing and load estimation methods.
4. To develop the models of the building comfort analysis methodology.
5. Study of different radiant heating systems.
6. Study of different radiant cooling systems.
7. Study of different controls of radiant systems.
8. Study of computer aided design tools for radiant systems.
9. Study Hybrid heating and cooling demonstration projects.
10. Case Studies.

Reference Books:

1. Radiant Heating and Cooling by Richard D. Watson and Kirby S. Chapman.
2. Radiant floor heating by R. Dodge Woodson
3. Radiant Heating and cooling manual by John Siegenthaler and Lawrence Drake.
4. Heating and Cooling of Buildings: Design for Efficiency by Kreider J. F., Rabl A. and Curtiss Peter