



Department of Sustainable Energy Engineering Indian Institute of Technology Kanpur

Proposal for a New Course

Course title	: Heating, Ventilation, and Air-conditioning of Buildings
Number	: SEE-618
Credits (L-T-P [C])	: 3-0-0-9
Departments proposing the course	: Sustainable Energy Engineering
Name of the proposer	: Aakash Chand Rai
Offered for	: PG Students of SEE/other departments or programs 3/4 th year UG students
Status of the course	: PG Elective/ UG Elective
Prerequisite(s) for the course	: Consent of instructor
Faculty members interested in teaching	: Faculty members of ME and CE
Other departments/programmes of whose the students are expected to take up the course	: ME and CE

Course objectives

This course aims to equip the students with a fundamental understanding of buildings' thermal behaviour. The students will then be introduced to the design and analysis of heating, ventilation, and air-conditioning (HVAC) systems for maintaining comfortable and healthy indoor environments. Finally, the course will focus on building energy simulation, climate impact assessment, and net-zero buildings.

Expected learning outcomes

The students will be able to understand the thermal behaviour of buildings and perform detailed design and analysis of HVAC systems. They will be able to conduct building energy simulations and climate impact analysis. They will also be able to appreciate net-zero building design practices.

Course outline

Energy use in buildings: Building sector's energy usage and associated greenhouse gas (GHG) emissions.

HVAC systems and psychrometry: Common HVAC systems (all-air, air-water, and all-water), moist air properties, and moist air processes for HVAC system design.

Thermal comfort, indoor air quality, and indoor infection transmission: Physiological considerations in comfort, environmental comfort indices, comfort conditions, adaptive thermal comfort, indoor air quality concerns, common air pollutants and their control, airborne infection transmission: causes and mitigation techniques.

Heating load: Steady-state building heat transfer, indoor and outdoor design conditions, and heating load calculation.

Solar radiation: Sun's motion as seen from the earth, solar time, solar angles, solar irradiation, and heat gain through fenestration.

Cooling load: Heat gain, cooling load, heat extraction rate, indoor and outdoor design conditions, and cooling load calculation procedures.

Energy calculations and building simulation: Degree day method, weather files, and software tools for energy simulation.

Climate change and net-zero buildings: GHG emission trends and drivers, representative concentration pathways, and net-zero buildings.

Lecture-wise breakup

Topics	# of lectures (approximate)
Energy use in buildings	3
HVAC systems	4
Psychrometry	6
Thermal comfort, indoor air quality, and indoor infection transmission	4
Heating load	4
Solar radiation	6
Cooling load	7
Energy calculations and building simulation	3
Climate change and net-zero buildings	3
	40

Text-books, reference books, suggested readings, and any other references

- Heating, Ventilating and Air Conditioning – Analysis and Design by McQuiston, Parker, and Spitler.
- ASHRAE Handbook—Fundamentals.
- Heating, Cooling, Lighting: Sustainable Design Strategies Towards Net Zero Architecture by Norbert M. Lechner and Patricia Andrasik.
- Refrigeration and Air-conditioning by C P Arora.

Course proposed by

Recommended/Not recommended

This course is approved/not approved



(Aakash Chand Rai)

Convener, DPGC (SEE)

Chairman, SPGC