CE 31100 Architectural Engineering
Sem. 1 and 2, Lecture 3, Cr. 3.
Restrictions: Sophomore status in the College of Engineering;
Prerequisite: ME 20000 Thermodynamics; Concurrent Prerequisite: CE 34000 Hydraulics or ME 30900 Fluid Mechanics or instructor permission.

Description: This course introduces building energy efficiency, thermal comfort, indoor environmental quality, and green building design concepts. The course covers engineering fundamentals required for the design and analysis of building systems such as thermodynamics, fluid mechanics, heat and mass transfer, and light and sound transmission. The course presents engineering principles and selected applications related to hygrothermal analysis of building enclosures, air conditioning processes in heating, ventilating and air-conditioning systems, building illumination, and building acoustics.

Level: Undergraduate Level

Course Instructors: Panagiota Karava, Ming Qu

Course Outline:

- **Introduction to building environmental loads and building environmental systems:** building function, building enclosure, heating ventilating and air-conditioning systems, weather and climate, heating, cooling and moisture loads, building energy efficiency, occupant thermal comfort, indoor environmental quality, green building design. (1 week)
- **Thermodynamics fundamentals for buildings:** thermodynamic properties of air, ideal gas law, gas-vapor mixtures, water vapor, dry and atmospheric air, psychrometric properties, psychrometric processes, psychrometric chart, human comfort and air conditioning, principles of the conservation of mass and energy to various air conditioning processes. (3 weeks)
- **Fluid mechanics fundamentals for buildings:** fluid properties, fluid flow through pipes and ducts, fluid friction, Moody Diagram, pressure drop and head loss calculation, parallel flow over flat plates. (1 week)
- **Heat transfer fundamentals for buildings:** Mechanisms of heat transfer, thermal conductivity, steady state heat conduction in plane walls, thermal resistance, physical mechanisms of forced convection, thermal boundary layer, forced convection over flat plates and inside pipes, natural convection over surfaces, natural convection inside enclosures, electromagnetic spectrum and thermal radiation, blackbody radiation, radiative properties of materials, view factors, radiation heat transfer. (3 weeks)
- **Mass transfer fundamentals for buildings:** Diffusion mass transport, mass diffusivity. (1 week)

- **Hygrothermal analysis of Buildings**: Heat flow and thermal gradients in simple wall assemblies, solar geometry, windows, vapor permeance, one-dimensional steady state vapor flow in wall assemblies, interstitial condensation (occurrence and quantity), moisture control. (2 weeks)
- **Heating Ventilating and Air Conditioning (HVAC) Systems**: Types of HVAC systems, air handling Units, HVAC distribution components, principles and calculation methods for simple Variable-Air-Volume systems (1 week)
- **Building illumination:** Physics of light, photometric quantities, lamps, electric lighting calculation methods. (1 week)
- **Building acoustics:** Physics of sound, room acoustics, noise criteria, sound transmission class of wall assemblies, calculation methods for sound absorption and transmission in buildings, sound isolation and control. (2 weeks).