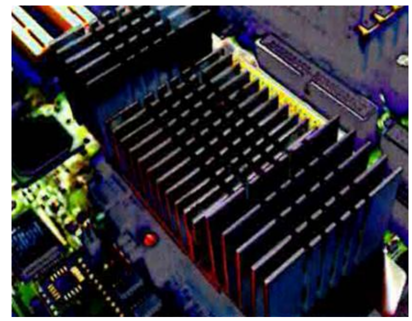
MECH295 SUMMER 2012

Engineering Fundamentals: Energy Conversion & Heat Transfer

Course Web Info: http://moodle.uvic.ca hosts the primary course info site.
Please check for announcements, assignments, and course materials.



Instructor: Rustom Bhiladvala rustomb@uvic.ca
Office Location: EOW 521 *Phone:* 721-8616
Office Hour: F 1:00-2:00pm. Email for other times.

Lecture Times: TWF 11:30-12:20
Lecture Location: ECS 116

Tutorial Time: T 5:00-5:50pm
Tutorial Location: ECS 116

Teaching Assistant: Ali Etrati etrati@uvic.ca ELW A254 Local -3180

Textbook: Moran. M., Shapiro. H., Munson. B., DeWitt. D.,
"Introduction to Thermal Systems Engineering," John Wiley & Sons, 2003.

Course Description: Conservation of energy and fundamentals of heat transfer are introduced and explored. An introduction to heat transfer modes (conduction, convection and radiation) is followed by more detailed investigations: transient and multi-dimensional conduction, heat exchanger design and problem solving methods.

Evaluation:

Online Profile	1%
Short Quizzes	4%
Problem Sets	15%
Midterm Exams(2)	65%
Final Quiz	15%

Major topics:	[1] Energy conversion & heat transfer for Electrical Engineers: Chip cooling – transistor performance, chip design for low power. Sustainable energy –role of smart grids, solar photovoltaics. Scope of fluid-thermal sciences. Definitions: open, closed, isolated systems; property, state, cycle, equilibrium; pure substance. Examples. [2] Processes. Path and point functions. Quasi-equilibrium processes. Forms of Energy. Heat and work interactions. Examples. First Law of Thermodynamics – energy balance for closed systems. [3] Properties of a pure substance. Liquid, vapour and two-phase property data from tables. T-v, P-v, T-s diagrams. Property relations. Thermal and caloric equations of state. Ideal gas model. Isothermal, isobaric, isochoric, adiabatic, polytropic processes. Examples. [4] Cyclic Processes. Second Law of Thermodynamics –reversibility; limits of heat engine and refrigeration cycles. Performance of power and refrigeration/ heat pump cycles. [5] Definition and use of the property entropy for processes. Isentropic process in closed systems. Evaluating entropy for incompressible substances and for ideal gases. [6-7] Introduction to Steam powerplant. Calculations for the Brayton cycle for gas turbine engines. Open systems –mass, energy, entropy rate balances. Examples of component calculations: heat exchangers, nozzles, compressors and turbines. Isentropic efficiency. [7-8] Basic cycle calculations for gasoline, diesel and vapour power cycles and for refrigeration cycles. [9] Introduction to Heat transfer modes. Conduction –Fourier's Law. Convection –Newton's Law of cooling; free and forced convection. Radiation –Blackbody radiation. Stefan-Boltzmann Law; emissivity, absorptivity and reflectivity of surfaces; view factors and radiative heat exchange. Heat Conduction: steady, 1-D, conduction –plane, radial and spherical geometries. Thermal resistance and electrical analogies. Composite wall with examples. [10] Heat conduction with energy generation. Fins; fin cooling example problems; fin performance parameters. Transient conduction -lumped capacitance method; Biot and Fourier number use. Examples. [11] Transient conduction: -spatial variation -plane, radial, spherical geometries; calculation examples for glass and microelectronics cooling. Multidimensional conduction. [11-13] Forced Convection in laminar and turbulent external flow -flat plate thermal and hydrodynamic boundary layers; correlations for cylinders, spheres and other geometries. Natural convection –importance in global climate systems -calculations for vertical and horizontal plates and other geometries. Internal flow in pipes and channels. Parallel and counterflow heat exchangers. Review.