



SYLLABUS

Thursday June 14, 2012: afternoon session

Fundamentals of heat transfer and heat exchangers design

Introduction to heat transfer: basic principles and equations, definition of the overall heat transfer coefficients and heat exchanger design methodology (LMTD, ϵ -NTU). Compact heat exchangers: definition, design description, trends (minichannels, microchannels). Hands on heat exchangers: car evaporator car heater and engine intercooler. Lab visit, new labs of Energy Institute in NeTME Centre.

Laser measurement methods in fluid mechanics

Particle Image Velocimetry method. Laser Doppler Anemometry method. Thermocouples (welding, measuring). Humidity measurement using psychrometer.

Monday June 18, 2012: afternoon session

Experimental methods I

Temperature measurement: principles, temperature probes (thermocouple, linear and nonlinear resistive probes), temperature measurement for thermal comfort assessment. Pressure measurement: principles and pressure probes. Air flow measurement: dynamics probes, hot wire anemometry, ultrasound principles and kata thermometer. Humidity measurement: principles, probes and psychrometer.

Tuesday June 19, 2012: morning session

Computational modelling of heat transfer and fluid flow

Introduction to numerical simulations. Governing equations: Navier-Stokes equations and boundary conditions. Short introduction to the turbulence. Adjacent heat transfer. Solution of Navier-Stokes equation: finite volume method. Numerical simulation of von Karman vortex street: visualization of the flow field, drag and lift force on body, estimation of the heat transfer coefficient. Example of real fluid flow over a cylinder on the experimental device: von Karman vortex street and its visualization using dye.

Tuesday **June 19, 2012**: afternoon session

Experimental methods II

Introduction and principles of infrared camera measurement. Radiation temperature, emissivity. Examples of usage. Tracer gas method: principles, used tracer gases, gas analyzers, examples of method in practice. Practice presentation of infrared camera measurement with thermogram analysis. Practical example of measuring the efficiency of exhaust by the tracer gas method in the laboratory.

Wednesday **June 20, 2012** morning session

Heating, ventilating and air conditioning in buildings

Heat balance of the human body: implications for environmental control. Built environment: shielding ourselves from outdoor climatic conditions. Indoor air quality: indoor and outdoor pollutants, health impact. Ventilation techniques: natural, mechanical and hybrid ventilation. Space heating: water loop systems, warm air heating, radiant heating, heat sources. Air-conditioning: cooling loads, vapor compression and absorption cooling cycles. Energy consumption and renewable energy sources. Building management systems. Computer simulations in HVAC and building design. Space heating demonstration panels. EBI: building management system. Experimental house.

Thursday **June 21, 2012**: morning session

Thermal comfort and HVAC in vehicles and aircrafts cabins

Human thermal comfort. Cabin environment: main parameters and influence on human. Specifics of cabin environment in car and aircraft cabins. HVAC system in car cabin. ECS system in aircraft cabin. Evaluation of thermal comfort in cabins. Equivalent temperature concept and comfort zones diagram. Basic principles of measurement with thermal manikins. Newton manikin: measurement system introduction. Demonstration of procedure of Newton manikin calibration. Examples of measurements with Newton: influences and impacts of different clothing, air speed, and water evaporation. Demonstration of measurements with breathing system.