FIRST SEMESTER 2015-2016
Course Handout (Part II)

Date: 03/08/2015

In addition to Part I (general Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **ME G631**
Course Title : **Advanced Heat Transfer**
Instructor-in-charge : **M.S. Soni**

1. Course Description:
Heat conduction with unsteady boundary conditions; recent advances in natural and forced convection; condensation and boiling phenomena; heat transfer in high speed flows; liquid metal heat transfer, radioactive metal heat transfer between surfaces in absorbing media; complex problems involving simultaneous conduction, convection and radiation.

2. Scope and Objective of the Course:
The course has the objective of presenting a broad outlook of the subject of heat transfer in a format that is suitable for a graduate student in engineering.

3. Text Book:

TB1: Holman J. P., "Heat Transfer", 9th Ed., McGraw-Hill, 2004
TB2: Adrian Bejan "Convection Heat Transfer", 3rd Edition, Wiley 2004

4. Reference Books
R1: Latif M. Jiji., "Heat Conduction", 3rd Edition, Springer, 2009
R2: John H Leinhard IV & John H Leinhard V, "A Heat transfer Text book", 3rd Edition, Phlogiston Press, 2006.
R3: G.S.H.Lock, "Latent Heat Transfer-An Introduction to Fundamentals, Oxford University press, 1996.
R4: S. V. Patankar, "Numerical Heat Transfer and Fluid Flow," Hemisphere Publishing Corporation, 1980.
R5: M. F. Modest, " Radiative Heat Transfer", Academic Press, 2003, 2 nd edition

5. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Ref. Chap./ Sec. (Book)
1-2	Introduction to Heat Transfer, Modes of heat transfer, Conservation of Energy requirement, 3D Heat Diffusion equation.	Basic concepts	Ch. 1 (TB1)
3-6	Mathematical, Graphical and Numerical analysis of 2-D heat conduction, Solution techniques.	Two Dimensional steady-state conduction	Ch. 3 (TB1)
7-12	Introduction, Lumped heat capacity system, Transient heat flow in a semi-infinite solid, Biot & Fourier number, Heisler charts, Improved lumped models	Transient conduction	Ch. 4 (TB1) Class notes & Research Papers
13-18	Numerical methods Discretization concepts, Structure of discretization method, Method of deriving discretization equations by FDM and FVM and solution method for conduction heat transfer.	Steady-state & Transient conduction	Ch. 3 and 4 (R4)
19-21	Physical mechanism, radiation properties, radiation shape factor, heat exchange between nonblackbodies, infinite parallel surfaces, radiation shields, radiation network for an absorbing and transmitting medium, Solar radiation, effect of radiation on temperature measurement.	Radiation heat transfer	Ch. 8 (TB1)
22-25	Radiation exchange in enclosures. Introduction to numerical methods for radiation.	Radiation heat transfer	Ch. 16 (R5) Class notes & Research Papers
26-27	Mass conservation, Force balances (momentum equation), Scale analysis, Heat lines for visualizing convection.	Fundamental principles	Ch.1 (TB2)
28-29	Boundary layer concept, Velocity and thermal boundary layer, Integral solutions, Similarity solutions, Effect of wall heating conditions,	Laminar Boundary layer	Ch.2 (TB2)

	Effect of flow through wall: Blowing and Suction, Effect of longitudinal pressure gradient.		
30-31	Hydrodynamic entrance length, Review of duct flow, Heat transfer to developing flow, Thermally and Hydraulically Developing Flow.	Laminar duct flow	Ch.3 (TB2)
32-34	Laminar boundary layer equations for natural convection, Scale analysis for high and low Pr number, Integral and similarity solutions, Combined natural and forced convection, review of heat transfer results including the effect of turbulence, Introduction to free convection in enclosures.	Natural convection	Ch.4, 5 (TB2)
35-36	Turbulence fundamentals, Boundary layer equations for turbulent flow, Heat Transfer analogies, Review of equations for internal and external turbulent flow.	Turbulent flow	Ch.7, 8 (TB2)
37-38	Liquid metal heat transfer, fundamentals and applications.	Liquid metal heat transfer	Ch.4 (R3)
39-40	Review of fundamental condensation and boiling heat transfer, Contact melting and lubrication, Melting by natural convection.	Convection with change of phase	Ch.10 (TB2)

6. Evaluation Scheme:

Component	Duration	Weightage	Date and Time	Remarks
Mid-Semester Test	90 min.	30%	5/10 4:00 - 5:30 PM	OB
Comprehensive Exam	3 hrs.	40%	2/12 AN	CB
Project	-	15%	Continuous	-
Assignment	-	15%	Continuous	Take home

7. Mid-semester grading: It will be announced normally in the month of October. It is done in the same manner as that of the final grading

Chamber Consultation Hours: To be announced in the class.

Notices: All notices related to this course will be put on the **Course Web/ Mechanical Engineering Department notice board** only.

Make-up Policy: Make-up will be given only to the genuine students as per rules. The request application for make-up test must reach the Instructor-in-charge before commencement of the scheduled test (documentary proof is essential). No make-up will be allowed for the quizzes(if any)

Instructor-in-charge
ME G631.