



FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester I

Course Code: 102440101

Course Title: Advanced Heat Transfer

Type of Course: Core Course I

Course Objectives: The course is prepared to provide understanding of multi-dimensional heat transfer analysis for steady and transient condition. The present course also helps to learn about volumetric radiation.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	40 / 16	20 / 08	60 / 24	30 / 12	150 / 60

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	HEAT CONDUCTION Steady, one dimensional heat conduction equation with heat generation in different geometries - plane wall and cylinder with uniform heat generation, applications, heat transfer in common configurations, conduction shape factor. Steady two dimensional heat conduction: solution by method of separation of variables. Extended surfaces heat transfer: different fin geometries, differential equation for fin of variable cross sections, solution of fin equation for different boundary conditions, fin performance	8
2	TRANSIENT CONDUCTION Lumped system analysis, transient conduction in various geometries, one term approximate solutions, use of Heisler and Grober charts, semi-infinite solids, transient conduction in multi-dimensional systems: product solution for transient conduction in various geometries, Conduction with phase change - integral method, solidification and melting - numerical methods	8
3	CONVECTION Inclined and horizontal plates – the flow pattern and heat transfer, heat transfer from upper and lower surfaces of heated or cooled plates, tubes, vertical and inclined channels, enclosures, combined free and forced convection. General review, Laminar Flow: a similarity solution, Turbulent flow, mixed boundary layer conditions, flow across cylinders and spheres, Momentum and energy equation, tube banks – inline and staggered arrangement, packed beds, introduction to compact heat exchangers, convection heat and mass transfer	12



4	RADIATION Review of radiation principles - laws of thermal radiation - surface properties - radiative heat exchange among diffuse, gray and non-gray surfaces separated by non-participating media - gas radiation and radiation transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and convection	8
5	Micro-scale heat transfer- basics with applications	3
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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
10%	25%	30%	25%	10%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	Analysis of heat and mass transfer , Eckert and Drake, McGraw-Hill
2	Fundamentals of heat transfer , Grober, Erk and Grigull, McGraw-Hill
3	Fundamentals of heat transfer , F P Incropera and D P Dewitt, Wiley
4	Conduction heat transfer , P J Schneider, Addison-Wesley Publishing Company
5	Radiation heat transfer , Sparrow and Cess, McGraw-Hill
6	Thermal radiation heat transfer , R Siegel and J R Howell, Taylor & Francis
7	Convective Heat & Mass Transfer , William Morrow Kays, Michael E. Crawford, McGraw-Hill
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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand multi-dimensional heat conduction with different geometries with various application in thermal engineering	15
CO-2	Analyze steady state and transient heat conduction problems of real life Thermal systems	30
CO-3	Understanding of the heat transfer through free and forced convection	25
CO-4	Analyze radiation heat transfer problems of various thermal systems	20
CO-5	Understand applications of micro-scale heat transfer	10
CO-6	Click or tap here to enter text.	Click
CO-7	Click or tap here to enter text.	Click
CO-8	Click or tap here to enter text.	Click
CO-9	Click or tap here to enter text.	Click
CO-10	Click or tap here to enter text.	Click



List of Practicals / Tutorials:

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1	Basic experimentation on 1-D, steady state heat transfer without heat generation in different coordinate system
2	Studies on conduction heat transfer with heat generation for different Applications
3	Performance on extended surfaces with uniform cross section area with different conducting material
4	Performance on extended surfaces with variable cross section area
5	Performance on unsteady state heat transfer for heating and cooling of solid body
6	Studies on heat transfer analysis on cluster of tubes (Both staggered and in-line arrangement)
7	Performance on emissivity measurement for the test plate
8	Basic experimentation on Free and Forced convection
9	Studies and analysis of multidimensional conduction heat transfer
10	Studies of gray and non-gray gas radiation heat transfer in an enclosure
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Supplementary learning Material:

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Curriculum Revision:

Version:	1
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22