MeEn 444
Heat Transfer Laboratory

A 'Required' Course in Mechanical Engineering Program

2002-2004 Course Description: MeEn 444 - Heat Transfer. (Credit, 1 hour.) (Lab., 3 hours;). Presents an introduction to the application of conduction, convection, and radiation heat transfer. Emphasis on measurement of temperature, and its application for determination of heat transfer coefficients and heat exchanger performance. **Co-requisite: MeEn 442**

Textbook: "Heat Transfer Laboratory Manual," Revision 4.3, by Patrick F. Mensah

Laboratory: 2:00-4:50 pm TH, in Room No. 372 P. B. S. Pinchback Engineering Building

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References:

1. *Introduction to Heat Transfer*, by F. P. Incropera and D.P. De Witt, 3rd Edition, John Wiley and Sons, Inc., New York, 1996.
2. *Handbook of Heat Transfer*, by W. M. Rohsenow and J. P. Hartnett, McGraw-Hill Book Company, New York, 1973

Course Topics:

Laboratory Content: The following is a list of experiments conducted.

1. Linear and Radial Heat Conduction: This experiment demonstrates the unsteady and steady heat conduction through a brass rod in linear conduction arrangement and conduction through a brass disk heated from the center in radial conduction arrangement. By the use of the steady state attained at the end of the experiment the thermal conductivity of brass can be determined.
2. Heat Exchanger Apparatus: This apparatus is equipped with a number of tube-in-shell type heat exchangers with different wall material, which can be configured, to operate as either parallel flow or counter flow heat exchangers. It is also equipped with facilities to use either hot water or steam on the hot fluid side and cold water on the cold fluid side. Experiments determining the heat exchanger effectiveness are performed on this apparatus.
3. Film and Dropwise Condensation: This apparatus is equipped with an electric boiler with variable power source and a tube-in-shell type heat exchanger with a two tubes (one with polished surface and one with rough surface) to demonstrate the film and dropwise condensation phenomena. The effective heat transfer coefficients in film and dropwise condensation can be determined.
4. Temperature Measurement Bench: This set-up is equipped with facilities, which can be used to demonstrate Seebeck effect in thermocouples, facilities to calibrate different thermocouples, facilities for temperature measurement by resistance a thermometer as well as by a thermistor thermometer.
5. Free and Forced Convection: With this set-up free and forced convection experiments can be performed over heated surfaces of different shape: flat surface, triangular finned surface and pin finned surface. Adjustable flow velocities are obtained by variable speed fan. Determination of the heat transfer coefficient and study of different influencing parameters on convection can be performed.
6. Thermal Radiation Demonstrator: This equipment can be use to demonstrate thermal radiation principles such as angular dependence of emissive power of a black body, (Lambert's cosine law), Spectral distribution of thermal radiation, the value of the wavelength where emissive

power of a blackbody is maximum, Stefan-Boltzman law of thermal radiation and radiation absorption principles.

Course Objectives:

1. Instruct and practice empirical investigation of thermal processes and systems covered in MeEn 442 (Heat Transfer).
2. Instruct and practice concepts of experimental engineering including experimental planning and practical applications of experimental statistics.
3. Further develop the ability to organize and work in teams
4. Instruct and practice written and graphical communication of experiments data and findings

COURSE ASSESSMENT:

Course Objective	Intended Educational Outcomes	Means of Assessment	Criteria of Success	Program Edu. Objectives/ ABET (a-k, Me1-Me6)
Objective 1: Instruct and practice empirical investigation of thermal processes and systems covered in MeEn 442 (Heat Transfer).	1.1 Students will demonstrate facility in empirical thermal processes and systems by laboratory participation and written reports.	1. Conduction of experiments with written laboratory reports 2. Course opinion Survey 3. BKS competencies evaluation	1- 85% passing rate 2- 90% positive response 3- 80% will achieve critical level of performance (CLP)	Edu. Objective: 1 and 2 ABET: a, b, c, e, f, g, h, I, and Me1-Me4
Objective 2: Instruct and practice concepts of experimental engineering including experimental planning and practical applications of experimental statistics.	2.1 Students will demonstrate in practice concepts of experimental engineering including experimental planning and statistical methods	1. Conduction of experiments with written laboratory reports 2. Course opinion Survey 3. BKS competencies evaluation	1- 85% passing rate 2- 90% positive response 3- 80% will achieve critical level of performance (CLP)	Edu. Objective: 1 and 2 ABET: a, b, c, e, f, g, and Me1-Me4
Objective 3: Further develop the ability to organize and work in teams	3.1 Students will successfully plan and perform experiments and plan and accomplish report preparation in teams.	1. Conduction of experiments with written laboratory reports 2. Course opinion Survey 3. BKS competencies evaluation	1- 85% passing rate 2- 90% positive response 3. 80% will achieve critical level of performance (CLP)	Edu. Objective: 1,2, 3, 4, and 5 ABET: a, b, c, e, f, g, h, and Me1-Me4
Objective 4: Instruct and practice written and graphical communication of experiments data and findings	4.1 Students will prepare written reports of research data and findings with substantial graphical content	1. Conduction of experiments with written laboratory reports 2. Course opinion Survey 3. BKS competencies evaluation	1- 85% passing rate 2- 90% positive response 3- 80% will achieve critical level of performance (CLP)	Edu. Objective: 1,2, 3, 4, and 5 ABET: a, b, c, e, f, g, h, I, and Me1-Me4

ABET Category Content (as estimated by faculty who prepared this course description):

Engineering Science: 2.25 credits or 75%
Engineering Design: 0 75 credit or 25%

Prepared by: P. F. Mensah **Date:** 1/05/2003