MCT 4210
Heat Transfer

Course Description:
This course enables students to perform steady state and transient, one-dimensional conduction analyses, geometrically simple forced and free convection analyses for internal and external flows, and geometrically simple radiative heat transfer analyses. Students are introduced to numerical finite difference heat conduction analysis. Students also are familiarized with computational software used to solve multi-dimensional and transient conduction problems, as well as convective and radiative heat transfer involving complex geometries. Introduction to heat exchangers.

Credit Hours:
3 Credit Hours.

Prerequisite(s):
PHY 2140;

Co-requisite(s):
MAT 3450.

Textbook(s) Required:

Course Objectives:
Upon successful completion of this the student will be able to:

1. Solve one-dimensional steady state conduction problems in Cartesian, cylindrical, and spherical coordinate systems. [SO b, d,f]
2. Identify when a system can be modeled as steady state and one dimensional versus transient and multi-dimensional. [SO b, d,f]
3. Determine the critical insulation thickness for pipes.[SO b, d, f ]
4. Determine when the application of fins deter versus enhance heat transfer. [SO b, d, f]
5. Solve internal forced convection problems in ducts and external forced convection problems involving flow over simple geometries using empirical correlations. [SO b, d,f]
6. Solve free convection problems involving flow over simple geometries using empirical correlations.[SO b, d, f ]
7. Identify when the LMTD versus the NTU method of heat exchanger analysis may be used for designing thermal fluid system requiring heat exchangers. [SO b, d,f]
8. Solve radiative heat transfer exchange problems involving two or three bodies. [SO b, d, f]
9. To apply the model of a black body to simplify the analysis of a radiative heat transfer exchange problem.[SO b, d,f]
10. Identify the dominant modes of heat transfer governing a thermal fluid system as well as to explain the physical mechanism of the mode. [SO b, d,f]
12. To reiterate the physical meaning of the dimensionless parameters utilized in heat transfer analyses. [SO b, d, f]
13. Identify when computational tools are needed to solve thermal-fluid problems based on the complexity of the problem and the level of detail/precision required for the dependent variables. [SO a, b, d, f]
14. Exhibit responsibility in handling of thermal-fluid lab equipment and work effectively as a group in a laboratory environment. [SO c]

Topics Covered:
1. Steady state one dimensional conduction.
2. Numerical Methods
3. Internal flow forced convection.
4. External flow forced convection.
5. Free convection from simple geometries.
6. Heat exchanger analysis.
7. View factors.
8. Radiative heat exchange between two/three bodies.
9. Computational Fluid Dynamics: Capabilities.

Laboratory/Projects:
1. Project I. [SO g, M2]
2. Radiative Heat Transfer using Radiation Cube [SO c, g, M2]
3. Thermal Conductivity Apparatus [SO, c, g, M2]
4. Thermal Software Demonstration [So a]
5. Numerical Thermal Analysis I [SO g, M2]
6. Project II [SO g, M2]

Contributions to MCT Student Outcomes:

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<tr>
<th>Level</th>
<th>BSMCT Program Student Outcomes</th>
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<tr>
<td>2</td>
<td>a. an ability to select and apply the knowledge, techniques, skills, and modern tools of their disciplines to broadly-defined engineering technology activities</td>
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<tr>
<td>2</td>
<td>b. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies</td>
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<tr>
<td>2</td>
<td>c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes</td>
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<td>2</td>
<td>d. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives</td>
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<td>1</td>
<td>e. an ability to function effectively as a member or leader on a technical team</td>
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<td>3</td>
<td>f. an ability to identify, analyze, and solve broadly-defined engineering technology problems</td>
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<td>g. an ability to communicate effectively regarding broadly-defined engineering technology activities</td>
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<td>h. an understanding of the need for and an ability to engage in self-directed continuing professional development</td>
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<td>i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity</td>
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<td>j. a knowledge of the impact of engineering technology solutions in a societal and global context</td>
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<td>k. a commitment to quality, timeliness, and continuous improvement</td>
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M1 – MCT Design Track: Students in this track will demonstrate the ability to apply principles of materials and mechanics to the design and analysis of mechanical components and mechanisms.
M2 – MCT Energy Track: Students in this track will demonstrate the ability to apply principles of thermo-fluid sciences to the design and analysis of energy systems

M3 – MCT Manufacturing Track: Students in this track will demonstrate the ability to apply principles of materials and production techniques to the planning, implementation, and control of manufacturing processes

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<tr>
<th>Grade</th>
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<td>A</td>
<td>95-100</td>
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<td>A-</td>
<td>90-94</td>
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<td>B+</td>
<td>87-89</td>
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<td>B</td>
<td>83-86</td>
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<tr>
<td>B-</td>
<td>80-82</td>
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<td>C+</td>
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<td>C</td>
<td>73-76</td>
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<td>C-</td>
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<td>D+</td>
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<td>D</td>
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<td>F</td>
<td>Below 60</td>
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WITHDRAWAL POLICY:

Last day to drop with a tuition refund: End of 2nd Week of Semester
Last day to drop without a notation of W on the transcript: End of 4th Week
Final day to drop with W (ET Students): End of 8th Week

All drop/add activity during the first four weeks should be done by the student through Pipeline. Withdrawal after the fourth week requires the instructor’s permission and must be submitted on a Drop/Add form to the Registrar’s Office. Withdrawal after the ‘final drop’ date will only be permitted under exceptional circumstances and requires the permission of the Chair of the ET Division. A failing grade is not an acceptable reason for withdrawal after the ‘final drop’ date.

POLICY ON CHEATING:

Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment/exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure Academic Integrity, will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course and may be subject to additional penalties.

University / Department Policies:

Academic Misconduct
http://www.et.eng.wayne.edu/et/academicmisconduct/academicmisconduct.html
Withdrawal from Engineering Tech classes
http://www.et.eng.wayne.edu/et/withdrawal/withdrawal.html
Deferred Grades
http://www.et.eng.wayne.edu/et/deferredgrade/deferredgrade.html

Code of Ethics for Engineers:
http://cems.alfred.edu/courses/ces120/ethics/abet.html
http://cems.alfred.edu/courses/ces120/ethics/ieee.html
http://onlineethics.org/codes/
http://www.iit.edu/departments/csep/codes/coe/abet-a.html

Prepared by: