Module(Course Syllabus)Catalogue

2022-2023

College/ Institute	Erbil Technology College	
Department	Automotive Engineering technology	
Module Name	Heat Transfer	
Module Code		
Degree	Technical Diploma ☐ Bachelor * High Diploma ☐ Master ☐ PhD ☐	
Semester	6th Semester	
Qualification	Ph.D. in Mechanical Engineering	
Scientific Title	Lecturer	
ECTS (Credits)	6	
Module type	Prerequisite ☐ Core * Assist. ☐	
Weekly hours	4	
Weekly hours (Theory)	(2)hr Class	(162)Total hrs Workload
Weekly hours (Practical)	(2)hr Class	(162)Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	Dr. Lizan Mahmood Zangana	
E-Mail& Mobile NO.	Lizan.khorsheed@epu.edu.iq 07511220401	
Lecturer (Practical)	Dr. Lizan Mahmood Zangana	
E-Mail & Mobile NO.	Lizan.khorsheed@epu.edu.iq 07511220401	
Websites		

Course Description	This course is an introduction to the principal concepts and methods of heat transfer. The objectives of this integrated subject are to develop the fundamental principles and laws of heat transfer and to explore the implications of these principles for system
Course objectives	▪ The main objective of this course is to familiarize the students with the basic 3 heat transfer modes, namely conduction, convection and radiation, which are common in aerospace systems. The students are also equipped with the ability to identify the existing heat transfer mode(s) on a given problem, and then to analyze the problem by determining the involved heat transfer rates or temperature distributions. The relevant system of equations or differential equations is formed simply by the conservation of energy principle applied to a control volume of finite size or differential size. Following the introduction of Fourier's law for heat conduction, and derivation of the general heat diffusion equation in three dimensions, equations are simplified for one-dimensional problems. Applications to plane walls, with and without thermal energy generation (heat sources), extended bodies (fins), and non-uniform cross sections with quasi one-dimensional approach are made. The concept of equivalent thermal circuit and thermal resistance to conduction heat transfer is introduced. While solving one-dimensional conduction problems with convection over a surface and/or radiation, Newton's law of cooling for convection heat transfer that develops across the thermal boundary layer and/or the black body radiation formula are used for providing the necessary boundary condition at the surface. Following one-dimensional problems, an analytical solution method is taught for treating two-dimensional linear conduction problems without volumetric heat generation. Fundamental knowledge for drawing constant temperature lines (isotherms) and heat flow lines (adiabats) is also provided to appreciate heat transfer phenomena across 2-D bodies.
Student's obligation	▪ The student must attendance the hall 2 hour and 2 hour in practical lab the lecturer instruction wherein early attendance and bringing requisite tools and keep the hall clean and protect furniture. ▪ The student submits a weekly report about what have done in the Lab section. For examination, there are semester exam and final exam for the practical and the theory parts. During the class hours there will be some quizzes.

<table>
<tr><td>Required Learning Materials</td><td colspan="5">▪ To avoid student bared in the hall lecturer uses several tools, whiteboard, data show and other demonstrate tools to interest student.</td></tr>
<tr><td rowspan="13">Evaluation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td colspan="2">Paper Review</td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Assignments</td><td>Homework</td><td>5</td><td></td><td></td></tr>
<tr><td>Class Activity</td><td>2</td><td></td><td></td></tr>
<tr><td>Report</td><td>5</td><td></td><td></td></tr>
<tr><td>Seminar</td><td>5</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8</td><td></td><td></td></tr>
<tr><td colspan="2">Lab.</td><td>10</td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td>25</td><td></td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40</td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td>100</td><td></td><td></td></tr>
<tr><td>Specific learning outcome:</td><td colspan="5">Identify the relevant heat transfer modes involved in a problem.

Perform conduction heat transfer analysis analytically through one-dimensional single layer or composite wall systems, with and without volumetric thermal energy generation as well as convection and radiation heat transfer modes over the walls of the system.

Calculate the relevant dimensionless Biot number that plays a critical role in transient conduction analysis, and carry out analytical solutions to time-dependent conduction problems for complex shapes with low Biot numbers, and simplified shapes (1-D) with high Biot numbers.</td></tr>
</table>

	Develop an understanding of the physics of convection heat transfer and important dimensionless numbers, namely the Reynolds and Prandtl numbers that play a critical role in flow physics. Apply Newton's law of cooling for determining the convection heat transfer over a surface and more importantly determine the convection heat transfer coefficient required by this law using the flow conditions over the surface and appropriate correlating Nusselt number relation for the given surface geometry and flow condition, both in forced flow and buoyancy-driven flow situations. Learn the differences between internal and external flow fields. Develop an understanding of the effects of the boundary layer development on heat transfer. For internal flows, determine the hydrodynamic entry length and thermal entry length. Develop an understanding of the use of Grashof and Rayleigh numbers in a buoyancy-driven flow situation, which is known as free convection. Perform heat transfer calculations for different types of heat exchangers with parallel-flow and counterflow arrangements. Apply the log mean temperature difference (LMTD) or the Effectiveness-NTU method in calculations. Become familiarized with fundamental concepts of radiation heat transfer such as emission, irradiation, absorption, reflection, and transmission. Use the black body radiation relations in solutions of problems for which radiative heat transfer is important. Calculate the view factor for radiation exchange between surfaces and determine the net radiation exchange at a surface.

Course References:	**1.** “Fluid Mechanics, Fundamentals and Applications,” Y. A. Cengel, J. M. Cimbala, 2nd Ed., McGraw-Hill, 2009. **2.** “Fluid Mechanics for Chemical Engineers,” N. de Nevers, 3rd Ed., McGraw-Hill, 2004. **3.** “Fluid Mechanics for Chemical Engineers with Microfluidics and CFD,” J. O. Wilkes, 2nd Ed., Prentice Hall, 2005. **4.** “Fluid Mechanics,” F. M. White, 6th Ed., McGraw-Hill, 2008. “An Album of Fluid Motion,” M. Van Dyke, The Parabolic Press, 1982

Course topics (Theory)	Week	Learning Outcome
Chapter 1: Introduction and Basic Concepts	1	
Chapter 2: Heat Conduction Equation	2	
Chapter 3: Steady Heat Conduction	3	
Chapter 4: Transient Heat Conduction	4	
Chapter 5: Fundamentals of Convection	5	
Chapter 6: External Forced Convection	6	
Chapter 7: Internal Forced Convection	7	
Chapter 8: Natural Convection	8	

Chapter 9: Boiling and Condensation	9	
Chapter 10: Heat Exchangers	10	
Chapter 11: The Log Mean Temperature Difference Method	11	
Chapter 12: The Effectiveness–NTU Method	12	
Practical Topics	Week	Learning Outcome
Determination of Thermal Conductivity of Metal Rod.	1	
Determination of Thermal Conductivity of Liquid	2	
Determination of Thermal Conductivity of Insulating Material	3	
Determination of Overall Heat Transfer Coefficient of a Composite wall.	4	
Determination of Effectiveness on a Metallic fin	5	
Determination of Heat Transfer Coefficient in a free Convection on a vertical tube	6	
Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.	7	
Determination of Critical Heat Flux.	8	
Determination of Emissivity of a Surface.	9	
Determination of Stefan Boltzman Constant.	10	
Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers	11	
Performance Test on Vapour Compression Refrigeration.	12	