Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	Erbil Technical Engineering	
Department	Mechanical and Energy Engineering	
Module Name	Heat Transfer II	
Module Code	HET 601	
Degree	Technical Diploma ☐ Bachler ■ High Diploma ☐ Master ☐ PhD ☐	
Semester	Sixth	
Qualification	Ph.D. in Mechanical Engineering	
Scientific Title	Professor	
ECTS (Credits)	6	
Module type	Prerequisite ☐ Core ■ Assist. ☐	
Weekly hours		
Weekly hours (Theory)	(2)hr Class	(28)Total hrs Workload
Weekly hours (Practical)	(2)hr Class	(26)Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	Prof. Dr. Ahmed Mohammed Adham	
E-Mail & Mobile NO.	ahmed.adham@epu.edu.iq; +9647500271523	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites	https://academicstaff.epu.edu.iq/faculty/ahmed.adham	

Course Book

<table>
<tr><td>Course Description</td><td colspan="5">The science of thermodynamics deals with the amount of heat transfer as a system undergoes a process from one equilibrium state to another, and makes no reference to how long the process will take. But in engineering, we are often interested in the rate of heat transfer, which is the topic of the science of heat transfer. In this course, the convection heat transfer mechanism will be explored with a practical approach. Many real-life examples will be given to show the students the importance of this course and how helpful it can be for them in their practical life after graduation.</td></tr>
<tr><td>Course objectives</td><td colspan="5">The objective of this course is to study:
(1) The concept of convection heat transfer.
(2) Empirical correlation of convection heat transfer.
(3) Forced convection (Internal and External flow).
(4) Natural Convection.
(5) Heat Exchangers.</td></tr>
<tr><td>Student's obligation</td><td colspan="5">Student's obligation in the heat transfer course is:
• Attendance in the all theoretical and experimental lectures.
• Two quizzes, two home works and a seminar in the course.
• Examination at the mid and end semester.</td></tr>
<tr><td>Required Learning Materials</td><td colspan="5">• Using data show projector, white board and PowerPoint, Testing in department’s Laboratory.
• Publish all lecture notes in college website.</td></tr>
<tr><td rowspan="11">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="5">Assignments</td><td>Homework</td><td>5%</td><td>5 & 8</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>9</td><td></td></tr>
<tr><td>Seminar</td><td>5%</td><td>10</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>4 & 7</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>6</td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40%</td><td>12</td><td></td></tr>
<tr><td colspan="2">Total</td><td>100%</td><td></td><td></td></tr>
</table>

Specific learning outcome:	1- Overview on different heat transfer mechanisms 2- Introduction to convection heat transfer 3- Dimensionless group of parameters 4- Forced convection in both internal and external flows 5- Natural convection 6- Heat exchanger calculations
Course References:	1. Heat Transfer by: J. P. Holman 2. A Heat Transfer Textbook by: J. H. Lienhard VI and J. H. Lienhard V. 3. Heat and Mass Transfer by: Hans Dieter Baehr and Karl Stephan 4. Heat and Mass Transfer Data Book by: C. P. Kothandaraman and S. Subramanyan.

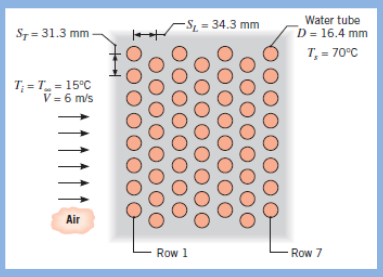
Course topics (Theory)	**Week**	**Learning Outcome**
Introduction to Heat Transfer Mechanisms	**1**	
Overview on Convection Heat Transfer	**2-3**	
External and internal forced convection	**4-6**	
Natural Convection	**7-9**	
Heat Exchangers	**10-12**	
Practical Topics	**Week**	**Learning Outcome**
Forced convection local heat transfer coefficient	**1-2**	
Average heat transfer coefficient of natural convection.	**3-5**	
Local heat transfer coefficient of natural convection.	**6-8**	
Natural convection heat transfer coefficient calculation	**9-12**	

Questions Example Design
Theoretical:

Note: Answer all questions. Lecture notes, Data book and J. P Holman text book are allowed.

Q(1)(40 Marks): A hot fluid at an average temperature of 200°C flows through a plastic pipe of 4 cm OD and 3 cm ID. The thermal conductivity of the plastic is 0.5 W/m2.K, and the convection heat transfer coefficient at the inside is 300 W/m2.K. The pipe is located in a room at 30°C, and the heat transfer coefficient at the outer surface is 10 W/m2.K. Calculate the overall heat transfer coefficient and the heat loss per unit length of pipe.

Q(2)(30 Marks): Pressurized water is often available at elevated temperatures and may be used for space heating or industrial process applications. In such cases it is customary to use a tube bundle in which the water is passed through the tubes, while air is passed in cross flow over the tubes. Consider a staggered arrangement for which the tube outside diameter is 16.4 mm and the longitudinal and transverse pitches are SL = 34.3 mm and ST = 31.3 mm. There are seven rows of tubes in the airflow direction and eight tubes per row. Under typical operating conditions the cylinder surface temperature is at 70 oC, while the air upstream temperature and velocity are 15 oC and 6 m/s, respectively. Determine the air-side convection coefficient?



Q(3)(30Marks): A horizontal plate 1 m × 0.8 m is kept in a water tank with the top surface at 60°C providing heat to warm stagnant water at 20°C. Determine the value of natural convection coefficient. Repeat the problem for heating on bottom surface and compare between both cases

Extra notes:

External Evaluator

I hereby confirm that I have reviewed the content of the course book and found it to be sufficient and covers the learning outcomes of this course.

Assist. Prof. Dr. Banipal Nanno Yaqob
17/9/2023