



Electrical and Renewable Energy Engineering Program

Course Specification - (2025-2026)

Heat Transfer – GME221

Academic Year	2025/2026	Semester	Spring
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1. Basic Information

Course Title (according to the bylaw)	Heat Transfer				
Course Code (according to the bylaw)	GME221				
Prerequisite:	Thermodynamics (1) - GME113				
Department/s participating in delivery of the course	Electrical and Renewable Energy Engineering				
Number of credit hours/points of the course (according to the bylaw)	Credit Hours	Contact Hours			
		Lecture	Tutorial	Practical	Total
	3	2	0	2	4
Course Type	Compulsory - Major Requirements of Electrical and Renewable Energy Engineering				
Academic level at which the course is taught	Second Level				
Academic Program	Bachelor of Engineering of Electrical and Renewable Energy				
Faculty/Institute	Faculty of Engineering				
University/Academy	Nahda University				
Name of Course Coordinator	Prof. Dr. Mohamed Saber Gad				
Course Specification Approval:	Department council		Faculty council		
Date of Approval of the course Specification:	13 / 9 / 2025		16 / 9 / 2025		



2. Course Overview

This course provides a comprehensive understanding of the mechanisms of heat transfer — conduction, convection, and radiation — and their applications in engineering systems. It builds upon thermodynamic principles to equip students with the analytical and practical skills necessary to design and evaluate thermal systems in power generation, refrigeration, HVAC, and energy conversion technologies. Students will study steady-state and transient conduction, forced and natural convection, heat exchangers, and thermal radiation between surfaces. The course also introduces heat transfer enhancement techniques, dimensionless analysis (Nusselt, Reynolds, Prandtl numbers), and empirical correlations for various flow and boundary conditions. Practical and computational approaches are emphasized, allowing students to apply analytical methods, numerical techniques, and simulation tools (such as ANSYS Fluent or MATLAB) to model and solve real-world heat transfer problems.

3. Course Learning Outcomes CLOs

Matrix of course learning outcomes CLOs with program outcomes POs (NARS/ARS)

Program Outcomes (NARS/ARS) (according to the matrix in the program specs)		Course Learning Outcomes Upon completion of the course, the student will be able to:	
Code	Text	Code	Text
A2	Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.	CLO5	Analyze different types of heat exchangers and their applications. Conduct and Solve engineering problems involving combined heat transfer modes. Analyze heat transfer equations to real engineering systems.
A10	Acquire and apply new knowledge; and practice self, lifelong and other learning strategies	CLO1	Acquire and define basic modes of heat transfer: conduction, convection, and radiation. Explain the physical mechanisms governing heat transfer processes.
		CLO4	Apply fundamental heat transfer laws (Fourier's law, Newton's law of cooling, Stefan-Boltzmann law).



Program Outcomes (NARS/ARS) (according to the matrix in the program specs)		Course Learning Outcomes Upon completion of the course, the student will be able to:	
Code	Text	Code	Text
D1	Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.	CLO2	Analyze fundamental heat transfer laws (Fourier's law, Newton's law of cooling, Stefan-Boltzmann law).
		CLO3	Design and model thermal systems in power generation, refrigeration, HVAC, and energy conversion technologies.

4. Teaching and Learning Methods

1. Interactive Lectures
2. Self-Learning
3. Field Visits
4. Discussion
5. Experimental Learning

Course Schedule

Number of the Week	Scientific content of the course (Course Topics)	Total Weekly Hours	Expected number of the Learning Hours				
			Lecture Hours	Tutorial Hours	Practical Hours	Self-learning (Assignments/Project)	Other
1	Thermal Conduction: The General Equation, Steady One-Dimensional Conduction, Conduction without Heat Generation, Plane Wall, Composite Plane Wall	6	2	0	2	2	-
2	Composite Plane Wall Subjected to Convection, Overall Heat Transfer Coefficient, Cylindrical Shell, Composite Cylindrical Wall Subjected to Convection, Spherical Shell, Composite Spherical Shell Subjected to Convection	6	2	0	2	2	-
3	Extended Surfaces (Fins), Conduction with Uniform Internal Heat Generation, Conduction with Variable Thermal Conductivity	6	2	0	2	2	-



4	Steady Two Dimensional Conduction, Unsteady One Dimensional Conduction (Transient Conduction), Periodic Conduction.	6	2	0	2	2	-
5	Convection: Types of Convection, Dimensionless Groups, Dimensional Analyses	8	2	0	2	2	Quiz 1 (2 Hr)
6	Buckingham's Pi Theory, Dimensionless Groups in Convection, Natural Convection, Forced Convection.	6	2	0	2	2	-
7	Mid Term Exam						
8	Heat Exchanger: Heat Exchanger Types, Logarithmic Mean Temperature Difference, Effectiveness of Heat Exchangers.	6	2	0	2	2	-
9	Thermal Radiation: Basic Concepts, Stefan-Boltzmann Law, Planck's Law, Radiation	6	2	0	2	2	-
10	Properties of Real Surfaces, Emissivity and Absorptivity, Kirchoff's Law, Emissivity of Real Surfaces, Gray Surfaces, Selective Surfaces	8	2	0	2	2	Quiz 2 (2 Hr)
11	Heat Exchange by Radiation, Heat Exchange between Two Planes	6	2	0	2	2	-
12	Heat Exchange between Two Cylinders or Spheres	6	2	0	2	2	-
13	Heat Exchange between Gray Surfaces, View Factors	6	2	0	2	2	
14	Mass Transfer, Fick's Law of Diffusion	6	2	0	2	2	-
15	Revision	6	2	0	2	2	-
16	Final Exam						

5. Methods of students' assessment

No.	Assessment Methods *	Assessment Timing (Week Number)	Marks/ Scores	Percentage of total course Marks
1	Mid-term written Exam	7	20	20%
2	Final Written Exam	16	40	40%
3	Assignments	2 - 14	15	15%
4	Quizzes	5, 10	15	15%
5	Final Practical Exam	15	10	10%



6. Learning Resources and Supportive Facilities

Learning resources (books, scientific references, etc.) *	The main (essential) reference for the course	1) Yunus A. Cengel, Afshin J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Co., 2025. 2) John H. Lienhard V, A Heat Transfer Textbook, 6 th edition, Massachusetts Institute of Technology, 2024.
	Other References	Artur Bartosik, Dariusz Asendrych, Numerical Heat Transfer and Fluid Flow 2022, MDPI, 2023.
	Electronic Sources	www.ekb.eg
	Learning Platforms	https://lms.nub.edu.eg/login/index.php
Supportive facilities & equipment for teaching and learning	Devices/Instruments	Data Show
	Supplies	White Board
	Electronic Programs	-----
	Skill Labs/ Simulators	—
	Virtual Labs	—
	Other (to be mentioned)	Lecture Hall and Laboratory Usage

Prof. Dr. Mohamed Saber Gad
Course Coordinator

Dr. Mohamed Kourany Saad
Program Coordinator