The University of Jordan
School of Engineering
Department of Mechatronics Engineering
2nd Semester – A.Y. 2024/2025

Course:	**Thermal Sciences for Mechatronics – 0908344 (3 Cr. – RequiredCourse)**
Instructor:	Prof. Mohammad Kilani Office: Mechatronics Dept., 3rd Floor, Tel: 5355000 ext. 23033 Email: mkilani@ju.edu.jo
Course website:	https://elearning.ju.edu.jo
Catalog description:	Introduction to fluid power systems. Basics of hydraulics systems including basic theory, energy, power, losses, and flow types. Theory and applications of engineering thermodynamics, heat transfer and fluid mechanics. Basic principles of fluid mechanics. Fluid statics. Conservation laws. Energy equations. Flow in pipes. Fundamental concepts of thermal sciences such as temperature, pressure, internal energy, work, heat, enthalpy, properties of a pure substance. Applied thermal sciences, first and second laws of thermodynamics, internal and external combustion, heat engine cycles, heat pump cycles, mixtures, fuels and combustion, and their associated engineering components and subsystems. Heat transfer and its essential mechanisms by conduction, convection, and radiation.
Prerequisites by course:	904222 Dynamics (pre-requisite)
Prerequisites by topic:	The student should have the basic knowledge of Physics, mathematics and chemistry
Textbook:	**Fundamentals of Thermal-Fluid Sciences, Y. A. Cengel, J. M. Cimbala and R. H. Turner, McGraw Hill, 2017, 5th Ed., SI Units**
References:	1. Lecture notes 2. Sonntag, Borgnakke, and Van Wylen, "Fundamentals of Thermodynamics", 5th ed., John Wiley and Sons, Inc., 2005 3. Roberson, and Crowe, "Engineering Fluid Mechanics", 6th ed., John Wiley and Sons, Inc., 1997. 4. Incropera, and DeWitt, "Heat and Mass Transfer", 4th ed., John Wiley and Sons, Inc., 1996. 5. Ganesan, Internal Combustion Engines, 4th Edition, McGraw-Hill, 2012
Schedule:	16 Weeks, 3 hours weekly including exams. Online using Moodle & Teams
Course goals:	The objective of this course is to teach the students the basics of material science and the main methods of manufacturing used in the industry

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

		[SO]
Upon successful completion of this course, a student should:		
1.	Understand the basics concepts of thermodynamics, first and second laws of thermodynamics, closed and open systems. Applications of heat engines, refrigerators, and heat pumps. Carnot cycles.	[1]
2.	Understand the basics of fluid mechanics; statics and dynamics. Understand the concepts of fluid flow, energy losses, major and minor losses during flow in a conduit, Reynolds number.	[1]
3.	Understand the principle heat transfer mechanisms; conduction, convection and radiation. Understand concept of thermal network and analogy between thermal circuits and electrical circuits. Understand the transient heat conduction, lumped capacitance method and its applications	[1]

Course topics:		**Hrs**
1.	General introduction to class three subjects (Thermodynamic, fluid mechanics, and heat transfer)	1
2.	Specific introduction to Thermodynamic concepts and definitions.	3
3.	Introduction to energy and concept of conservation of energy in physical sense. Mechanisms of energy transfer by mass, work, and heat.	3
4.	Properties of pure substance and thermodynamic properties, problem solving.	2
5.	First law of thermodynamic: Closed system.	3
6.	First law of thermodynamic: Open system.	3
7.	Second Law of Thermodynamic, Carnot heat engine, refrigerators, heat pumps, reversible process.	2
8.	Pressure, manometers and Barometers. Introduction to Fluid statics, pressure variation with depth, calculation of hydrostatic force and line of action on submerged surfaces.	3
9.	Efficiencies, Energy equation for flowing fluid, Bernoulli equation, and energy analysis of steady flows.	3
10.	Flow in a conduit, entrance length, fully developed flow, major and minor losses and piping system.	3
11.	Mechanisms of heat transfer: Conduction, convection, and radiation and simultaneous heat transfer mechanisms.	3
12.	Steady Heat Conduction, concept of thermal network, analogy to electrical resistance.	2
13.	Transient heat conduction, Lumped capacitance method.	2

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture; Absence of more than 7 hours will result in the expulsion of the student from the course.

Assessment & grading policy:

Midterm Exam	30%	
Project	20%	
Final Exam		50%
Total		**100%**