21.Course Specification of Thermodynamics and Heat Transfer

I.Course Identification and General Information:						
.1	Course Title:	Thermodynamics and Heat Transfer.				
.2	Course Code & Number:	MT104.				
.3	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar	Pr.	Tu.	
		2	-	-	2	3
.4	Study level/ semester at which this course is offered:	Second Year- First Semester.				
.5	Pre –requisite (if any):	Mathematics (1) and Mathematics (2).				
.6	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered:	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
.9	Location of teaching the course:	Mechatronics Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Eng. Hamoud A. Al-Nahari.				
11.	Date of Approval:					

II.Course Description:

This course will cover main topics in thermodynamics and heat transfer. These topics are: energy analysis, and energy transfer as work and heat, and the laws of thermodynamics will be taken into account. The processes of heat transfer: Conduction, Convection and Radiation will be covered with detailed numerical problems. The course will also focus on the solutions of steady flows.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Define the basic principles of thermodynamics and heat transfer.	A2
a2.	Describe the modes of heat transfer and thermodynamics applications in the actual field.	
b1.	Propose a solution procedure to solve problems in field of thermodynamics and heat transfer applications.	B1

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Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

b2.	Analyze problems, conclude solutions and demonstrate creative thinking.	
c1.	Perform calculations related to applications of thermodynamics and heat transfer with using tables and charts.	C2
c2.	Apply software programs for solving equations and designing engineering systems.	
d1.	Co-operate coherently and successfully with team in assignments.	D1
d2.	Justify results with different ideas.	D6

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1. Define the basic principles of thermodynamics and heat transfer. **a2.** Describe the modes of heat transfer and thermodynamics applications in the actual field.	• Lectures. • Tutorials. • Interactive class discussion.	• Written tests and quizzes. • Homework and assignments.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1. Propose a solution procedure to solve problems in field of thermodynamics and heat transfer applications. **b2.** Analyze problems, conclude solutions and demonstrate creative thinking.	• Lectures. • Tutorials. • Interactive class discussion.	• Written tests and quizzes. • Homework and assignments.

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1. Perform calculations related to applications of thermodynamics and heat transfer with using tables and charts. **c2.** Apply software programs for solving equations and designing engineering systems.	• Lectures. • Tutorials. • Interactive class discussion. • Simulations using computer software	• Written tests and quizzes. • Homework and assignments.

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(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1. Co-operate coherently and successfully with team in assignments. **d.2** Justify results with different ideas.	• Lectures. • Tutorials. • Exercises and homework. • Interactive class discussion. • Simulations using computer software.	• Written tests and quizzes. • Homework and assignments.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction: Basic Concepts of Thermodynamics, Thermodynamic Properties and Systems.	a1, a2, b1, b2.	• Thermodynamics and Energy. • The Four laws of the Thermodynamics. • Forms of Energy. • Closed and Open Systems. • Properties of a System.	1	2
2.	Properties of Pure Substances and Equations of State.	a1, a2, b1, b2.	• Pure Substance and Phase Change. • Processes of Pure Substances. • Property Diagrams for Phase Change Processes. • Property Diagrams and Tables for Phase Change Processes. • The Ideal Gas and the Equation of State.	1	2
3.	The Four Laws of the Thermodynamics.	a1, a2, b1, b2, c1, c2, d1, d2.	• Different Applications of the Laws. • Energy Balance.	1	2
4.	Closed and Open Systems.	a1, a2, b1, b2, c1, c2, d1, d2.	• Energy Balance for Steady Flow Systems. • Energy Balance for Non-Steady Flow Systems.	1	2

5.	Introduction to the Heat Transfer.	a1, a2, b1, b2, c1, c2, d1, d2.	• Introduction to Conduction, Convection, and Radiation.	1	2
6.	Conduction Heat Transfer.	a1, a2, b1, b2, c1, c2, d1, d2.	• Steady Heat Conduction in Plane Wall. • Thermal Contact Resistance. • Heat Conduction in Cylinders and Spheres. • Critical Radius of Insulation. • Heat Transfer from Finned Surfaces.	2	4
7.	Mid-Term Exam.	a1, a2, b1, b2, c1, c2.	• The First 6 Chapters.	1	2
8.	Convection Heat Transfer-Natural Convection.	a1, a2, b1, b2, c1, c2, d1, d2.	• Natural Convection over Surfaces. • Natural Convection from Finned Surfaces. • Natural Convection inside Enclosures.	2	4
9.	Convection Heat Transfer-Forced Convection.	a1, a2, b1, b2, c1, c2, d1, d2.	• Physical Mechanism of Convection. • Classification of Fluid Flows. • Drag Force and Heat Transfer in an External Flow. • Parallel Flow over Flat Plates. • Flow across Cylinders, Spheres, and Tube Banks.	2	4
10.	Radiation Heat Transfer: Processes and Properties.	a1, a2, b1, b2, c1, c2, d1, d2.	• Introduction and Basic Concepts. • Radiation Heat Fluxes. • Radiation Intensity. • Black-Body Radiation. • Emission from Real Surfaces.	2	4

			• Absorption, Reflection, and Transmission by Real Surfaces.		
11.	Cooling of Electronic Equipment and its Applications.	a1, a2, b1, b2, c1, c2, d1, d2.	• Cooling Load of Electronic Equipment. • Electronic Cooling in Different Applications.	1	2
12.	Final Exam.	a1, a2, b1, b2, c1, c2.	• All the Chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Tutorial Aspects

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Introduction: Basic Concepts of Thermodynamics, Thermodynamic Properties and Systems.	1	2	a1, a2, b1, b2.
2.	Properties of Pure Substances and Equations of State.	1	2	a1, a2, b1, b2.
3.	The Four Laws of the Thermodynamics.	1	2	a1, a2, b1, b2, c1, c2, d1, d2.
4.	Closed and Open Systems.	1	2	a1, a2, b1, b2, c1, c2, d1, d2.
5.	Introduction to the Heat Transfer.	1	2	a1, a2, b1, b2, c1, c2, d1, d2.
6.	Conduction Heat Transfer.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.
7.	Convection Heat Transfer-Natural Convection.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.
8.	Convection Heat Transfer-Forced Convection.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.
9.	Radiation Heat Transfer: Processes and Properties.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.
10.	Cooling of Electronic Equipment and its Applications.	**1**	**2**	a1, a2, b1, b2, c1, c2, d1, d2.

Number of Weeks /and Units Per Semester	**14**	**28**	

V.Teaching strategies of the course:

Lectures, Tutorials, Exercises and homework, Interactive class discussion, Simulations using software.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Exercise and Home Work.	a1, a2, b1, b2, c1, c2, d1, d2.	Weekly	5
2.	Project (single/group).	a1, a2, b1, b2, c1, c2, d1, d2.	12	10
3.	Quizzes.	a1, a2, b1, b2, c1, c2, d1, d2.	4 and 9	5
Total				**20**

VII.Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Homework/Tasks/Assignments and Project.	4, 9, 12	30	20 %	a1, a2, b1, b2, c1, c2, d1, d2.
2.	Mid-Term Exam.	8	15	10 %	a1, a2, b1, b2, c1, c2.
3.	Final Exam.	16	105	70 %	a1, a2, b1, b2, c1, c2, d1, d2
Total			**150**	**100%**	

VIII.Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

1.	Theodore L. Bergman, et al, 2011,"Fundamentals of Heat and Mass Transfer", 7th edition, John Wiley & Sons.
2.	Michael J. Moran and Howard H. Shapiro, 2011, "Fundamentals of Engineering Thermodynamics", 7th edition

2- Essential References.

1.	Cengel, Yunus, A., 2008, "Introduction to Thermodynamics and Heat Transfer", McGraw Hill, U.S.A.
2.	Cengel, Yunus, A., 2010, "Thermodynamics: An Engineering Approach, 6 th edition, McGraw Hill, U.S.A.
3.	Cengel, Yunus, A., 2008, "Heat Transfer: A Practical Approach", 2 nd edition, McGraw Hill, U.S.A.
3- Electronic Materials and Web Sites *etc*.	
	1. http:// pdfsh.com/introduction+to+thermodynamics+and+heat+transfer. 2. http://www.pdfkita.net/thermodynamics-an-engineering-approach-with-student-resources-dvd-7th-edition.

IX.Course Policies:

.1	**Class Attendance:** - The students should have more than 75% of attendance according to rules and regulations of the faculty.
.2	**Tardy:** - The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.
.3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
.4	**Assignments & Projects:** - The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.
.5	**Cheating:** - If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquiries.
6.	**Plagiarism:** - If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university.
7.	**Other Policies:** -All the teaching materials should be kept out the examination hall and mobile phones are not allowed. -Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university.

Reviewed By	Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat.

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

	President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi. Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed. Asst. Prof. Dr. Munaser Alsubari.

Course Plan of Thermodynamics and Heat Transfer

I.Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Asst. Prof. Dr. Eng. Hamoud A. Al-Nahari.	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	h_nahary@hotmail.com						

II.Course Identification and General Information:

1.	Course Title:	Thermodynamics and Heat Transfer				
2.	Course Number & Code:	MT104.				
3.	Credit hours:	**C.H**				**Total CR. HRS.**
		Th.	**Seminar**	**Pr.**	**Tu.**	
		2			2	3
4.	Study level/year at which this course is offered:	Second Year- First Semester.				
5.	Pre –requisite (if any):	Mathematics (1) and Mathematics (2).				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of delivery:	Lectures and Tutorials.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

III.Course Description:

This course will cover main topics in thermodynamics and heat transfer. These topics are: energy analysis, and energy transfer as work and heat, and the laws of thermodynamics will be taken into account. The processes of heat transfer: Conduction, Convection and Radiation will be covered with detailed numerical problems. The course will also focus on the solutions of steady flows.

IV.Course Intended learning outcomes (CILOs) of the course

		Referenced PILOs
a1.	Define the basic principles of thermodynamics and heat transfer.	A2

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a2.	Describe the modes of heat transfer and thermodynamics applications in the actual field.	
b1.	Propose a solution procedure to solve problems in field of thermodynamics and heat transfer applications.	B1
b2.	Analyze problems, conclude solutions and demonstrate creative thinking.	
c1.	Perform calculations related to applications of thermodynamics and heat transfer with using tables and charts.	C2
c2.	Apply software programs for solving equations and designing engineering systems.	
d1.	Co-operate coherently and successfully with team in assignments.	D1
d2.	Justify results with different ideas.	D6

V.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction: Basic Concepts of Thermodynamics, Thermodynamic Properties and Systems.	• Thermodynamics and Energy. • The Four laws of the Thermodynamics. • Forms of Energy. • Closed and Open Systems. • Properties of a System.	1	2
2.	Properties of Pure Substances and Equations of State.	• Pure Substance and Phase Change. • Processes of Pure Substances. • Property Diagrams for Phase Change Processes. • Property Diagrams and Tables for Phase Change Processes. • The Ideal Gas and the Equation of State.	2	2
3.	The Four Laws of the Thermodynamics.	• Different Applications of the Laws. • Energy Balance.	3	2
4.	Closed and Open Systems.	• Energy Balance for Steady Flow Systems. • Energy Balance for Non-Steady Flow Systems.	4	2

5.	Introduction to the Heat Transfer.	• Introduction to Conduction, Convection, and Radiation.	5	2
6.	Conduction Heat Transfer.	• Steady Heat Conduction in Plane Wall. • Thermal Contact Resistance. • Heat Conduction in Cylinders and Spheres. • Critical Radius of Insulation. • Heat Transfer from Finned Surfaces.	6,7	4
7.	Mid-Term Exam.	• The First 6 Chapters.	8	2
8.	Convection Heat Transfer-Natural Convection.	• . Natural Convection over Surfaces. • Natural Convection from Finned Surfaces. • Natural Convection inside Enclosures.	9,10	4
9.	Convection Heat Transfer-Forced Convection.	• Physical Mechanism of Convection. • Classification of Fluid Flows. • Drag Force and Heat Transfer in an External Flow. • Parallel Flow over Flat Plates. • Flow across Cylinders, Spheres, and Tube Banks.	11,12	4
10.	Radiation Heat Transfer: Processes and Properties.	• Introduction and Basic Concepts. • Radiation Heat Fluxes. • Radiation Intensity. • Black-Body Radiation. • Emission from Real Surfaces. • Absorption, Reflection, and Transmission by Real Surfaces.	13,14	4
11.	Cooling of Electronic Equipment and its Applications.	• Cooling Load of Electronic Equipment. • Electronic Cooling in Different Applications.	15	2
12.	Final Exam.	• All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Tutorial Aspects

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Introduction: Basic Concepts of Thermodynamics, Thermodynamic Properties and Systems.	1	2	a1, a2, b1, b2.
2.	Properties of Pure Substances and Equations of State.	2	2	a1, a2, b1, b2.
3.	The Four Laws of the Thermodynamics.	3	2	a1, a2, b1, b2, c1, c2, d1, d2.
4.	Closed and Open Systems.	4	2	a1, a2, b1, b2, c1, c2, d1, d2.
5.	Introduction to the Heat Transfer.	5	2	a1, a2, b1, b2, c1, c2, d1, d2.
6.	Conduction Heat Transfer.	6,7	4	a1, a2, b1, b2, c1, c2, d1, d2.
7.	Convection Heat Transfer-Natural Convection.	8,9	4	a1, a2, b1, b2, c1, c2, d1, d2.
8.	Convection Heat Transfer-Forced Convection.	10,11	4	a1, a2, b1, b2, c1, c2, d1, d2.
9.	Radiation Heat Transfer: Processes and Properties.	12,13	4	a1, a2, b1, b2, c1, c2, d1, d2.
10.	Cooling of Electronic Equipment and its Applications.	14	2	a1, a2, b1, b2, c1, c2, d1, d2.
Number of Weeks /and Units Per Semester		**14**	**28**	

VI.Teaching strategies of the course:

Lectures, Tutorials, Exercises and homework, Interactive class discussion, Simulations using software

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Exercise and Home Work.	a1, a2, b1, b2, c1, c2, d1, d2.	Weekly	5
2.	Project (single/group).	a1, a2, b1, b2, c1, c2, d1, d2.	12	10

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3.	Quizzes.	a1, a2, b1, b2, c1, c2, d1, d2.	4 and 9	5
Total				**20**

VIII.Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Homework/Tasks/Assignments and Project.	4, 9, 12	30	20 %	a1, a2, b1, b2, c1, c2, d1, d2.
2.	Mid-Term Exam.	8	15	10 %	a1, a2, b1, b2, c1, c2.
3.	Final Exam.	16	105	70 %	a1, a2, b1, b2, c1, c2.
Total			**150**	**100%**	

IX.Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

1.	Theodore L. Bergman, et al, 2011,"Fundamentals of Heat and Mass Transfer", 7th edition, John Wiley & Sons.
2.	Michael J. Moran and Howard H. Shapiro, 2011, "Fundamentals of Engineering Thermodynamics", 7th edition

2- Essential References.

1.	Cengel, Yunus, A., 2008, "Introduction to Thermodynamics and Heat Transfer", McGraw Hill, U.S.A.
2.	Cengel, Yunus, A., 2010, "Thermodynamics: An Engineering Approach, 6 th edition, McGraw Hill, U.S.A.
3.	Cengel, Yunus, A., 2008, "Heat Transfer: A Practical Approach", 2 nd edition, McGraw Hill, U.S.A.

3- Electronic Materials and Web Sites *etc*.

1. http:// pdfsh.com/introduction+to+thermodynamics+and+heat+transfer.
2. http:// www.pdfkita.net/thermodynamics-an-engineering-approach-with-student-resources-dvd-7th-edition.

X.Course Policies:

Unless otherwise stated, the normal course administration policies and rules of the Faculty of Engineering apply. For the policy, see: ----------

.1 Class Attendance:

	- The students should have more than 75% of attendance according to rules and regulations of the faculty.
.2	**Tardy:** - The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.
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