# Module (Course Syllabus) Catalogue

# 2022-2023

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|---|---|---|
| College/ Institute | Erbil Technology College | |
| Department | AIT | |
| Module Name | Thermodynamics | |
| Module Code | THE505 | |
| Degree | Technical Diploma [ ] Bachelor [x]<br>High Diploma [ ] Master [ ] PhD [ ] | |
| Semester | 5 | |
| Qualification | Bachelor | |
| Scientific Title | Engineer | |
| ECTS (Credits) | 5 | |
| Module type | Prerequisite [ ] Core [ ] Assist. [x] | |
| Weekly hours | 3 | |
| Weekly hours (Theory) | ( 3 )hr Class | (188)Total hrs Workload |
| Weekly hours (Practical) | ( 0 )hr Class | ( )Total hrs Workload |
| Number of Weeks | 16 | |
| Lecturer (Theory) | Shelan M Mustafa | |
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| Lecturer (Practical) | Shelan M Mustafa | |
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| Websites | | |

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| **Course Description** | Thermodynamics is an essential elementary course for the majors of various disciplines of engineering such as mechanical, electrical, civil, materials, Industrial, Aerospace, and Biomedical, etc. All engineering disciplines are focusing on the efficient utilization of energy and converting it to other forms of energy to improve the human condition. This course mainly studies the scientific principles that deal with energy conversion among different forms, namely, fundamentals of equilibrium, heat, work, temperature, entropy, and internal and electrical energy. The physical science of heat and temperature, and their relations to energy and work, are analyzed on the basis of the four fundamental thermodynamic laws (zeroth, first, second, and third). These principles are applied to various practical systems, including electrical power plants, heat engines, refrigeration cycles and air conditioning. |
| **Course objectives** | To provide engineering students with the knowledge and skills necessary to solve both theoretical and practical thermodynamics problems. Understand the law of thermal and mechanical energy conversion.Understand the energy efficiency principles, methodologies, and analyses.Applications in thermodynamic theory to thermodynamic processes and cycles. |
| **Student's obligation** | ► The necessity of assignments is highlighted since they will assist the student in gaining a thorough understanding of the numerous topics and subtopics involved.<br>Consequently, each student will be required to take all examinations and tasks provided in the course with care. The answers to the assignments will be supplied after the submission deadline, and no examinations will be accepted after the deadline. Monday is the due date for all assignments, which are then graded over the following week.<br>► Students are required to be on time for class, as late causes disruption for everyone.<br>Students with an absence rate over 10% by the end of the course will not be permitted to take the final exam.<br>► Students are instructed to silence their cell phones during class because they can be a distraction. |
| **Required Learning Materials** | Thermodynamics: An Engineering Approach, 9th Edition Yunis Cengel and Michael Boles,2019 |

**Evaluation**

| Task | | Weight (Marks) | Due Week | Relevant Learning Outcome |
|---|---|---|---|---|
| Paper Review | | | | |
| Assignments | Homework | 10% | 3-14 | 1-6 |
| | Class Activity | 2% | 3-13 | 1-6 |
| | Report | | 3-14 | |
| | Seminar | 16% | 7 | 1-6 |
| | Essay | | | |
| | Project | | | |
| Quiz | | 8% | 4&8&12 | 1-6 |
| Lab. | | | | |
| Midterm Exam | | 14% | 8 | |
| Final Exam | | 50% | 14 | |
| Total | | 100% | | |

**Specific learning outcome:**

At the end of the course, the student is to be able to:

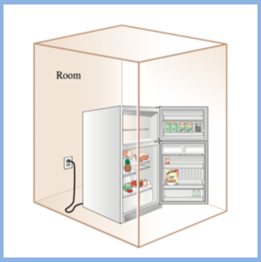
1. To understand the fundamental concepts and principles of thermodynamics in the context of the first and second laws and to apply such fundamentals in solving problems.
2. Identify the key physical principles and/or concepts to be used in solving the problem.
3. Sketch state/process diagrams or other appropriate graphical representations that are useful in solving the problem.
4. Work with equations (symbolic form) as far as possible before substituting numerical values.
5. Identify the tables, charts, or equations from which property data or other numerical values are taken.
6. show all units and unit conversions explicitly, When substituting numerical values into equations.

**Course References:**

| Course topics (Theory) | Week | Learning Outcome |
|---|---|---|
| **Chapter#1:** Introduction and Basic Concepts. | 1&2 | 1 |
| **Chapter#2:** Energy and the First Law of Thermodynamics. | 3&4 | 1 |
| **Chapter#3:** Evaluating Properties. | 5&6 | 2 |
| **Chapter#4:** Control Volume Analysis Using Energy. | 7&8 | 2,3 |
| Midterm Exam | 9 | |
| **Chapter#5**: The Second Law of Thermodynamics | 10&11 | 3&4 |
| **Chapter#6:** Entropy | 11&12 | 5&6 |
| Final exam preparation | 13 | |
| Final exam | 14 | |

## Questions Example Design

Q1/Consider an electric refrigerator located in a room. Determine the direction of the work and heat interactions (in or out) when the following are taken as the system:




(a) the contents of the refrigerator,
(b) all parts of the refrigerator including the contents, and
(c) everything contained within the room during a winter day.

Q2/An insulated room is heated by burning candles. Is this a heat or work interaction? Take the entire room, including the candles, as the system.

Q3/The following table shows the details of four continuous processes that make up a cycle. Complete the blanks in the table. Note that all values are in kJ. Is it a power cycle? If yes, calculate the thermal efficiency of the cycle.

| Process | ΔU | ΔKE | ΔPE | ΔE | Q | W |
|---|---|---|---|---|---|---|
| 1-2 | 1000 | -50 | 0 | | 1000 | |
| 2-3 | | 0 | 15 | -700 | | 900 |
| 3-4 | -550 | | 0 | -300 | | 0 |
| 4-1 | 400 | -300 | -50 | | 0 | |

Q4/A gas in a piston–cylinder assembly undergoes a compression process for which the relation between pressure and volume is given by $PV^n = Constant$. The initial volume is 0.1 m$^3$ , the final volume is 0.04 m$^3$ , and the final pressure is 2 bar. Determine the initial pressure, in bar, and the work for the process, in kJ, if (a) n = 0, (b) n = 1, (c) n = 1.3.

Solutions:

Q1/

a) From the perspective of the contents, heat must be removed in order to reduce and maintain the content's temperature(Qout -ve). Heat is also being added to the contents from the room air since the room air is hotter than the contents(Qin +ve).
b) Considering the system formed by the refrigerator box when the doors are closed, there are three interactions, electrical work and two heat transfers. There is a transfer of heat from the room air to the refrigerator through its walls(Qin +ve).. There is also a transfer of heat from the hot portions of the refrigerator (i.e., back of the compressor where condenser is placed) system to the room air(Qout -ve).. Finally, electrical work is being added to the refrigerator through the refrigeration system(Win -ve).
c) Heat is transferred through the walls of the room from the warm room air to the cold winter air(Qout -ve).. Electrical work is being done on the room through the electrical wiring leading into the room(Win -ve)..

Q2/

This is neither a heat nor a work interaction since no energy is crossing the system boundary. This is simply the conversion of one form of internal energy (chemical energy) to another form (sensible energy).

Q3/

| Process | ΔU | ΔKE | ΔPE | ΔE | Q | W |
|---|---|---|---|---|---|---|
| 1-2 | 1000 | -50 | 0 | 950 | 1000 | 50 |
| 2-3 | -715 | 0 | 15 | -700 | 200 | 900 |
| 3-4 | -550 | 250 | 0 | -300 | -300 | 0 |
| 4-1 | 400 | -300 | -50 | 50 | 0 | -50 |

Q4/

$$\boldsymbol{given: P_2 = 2\ bar, V_1 = 0.1 m^3, V_2 = 0.04 m^3}$$

$$constant = P_1 V_1^n = P_2 V_2^n$$

**(a) $n = 0$**

$$P_1V_1^0 = P_2V_2^0 \Rightarrow P_1 = P_2 = 2bar$$

$$W = P(V_2 - V_1) = 2bar(0.04 - 0.1)m^3 = -0.12\ bar.m^3 = -12\ KJ$$

**(b) $n = 1$**

$$P_1 = P_2\left(\frac{V_2}{V_1}\right)^n = 2\ bar\left(\frac{0.04m^3}{0.1m^3}\right)^1 = 0.8\ bar$$

$$W = P_1V_1 ln\frac{V_2}{V_1} = (0.08)bar * 0.1m^3)ln\frac{0.04m^3}{0.1m^3} = -0.073bar.m^3 = -7.3KJ$$

**(c) $n = 1.3$**

$$P_1 = P_2\left(\frac{V_2}{V_1}\right)^n = 2\ bar\left(\frac{0.04m^3}{0.1m^3}\right)^{1.3} = 0.607\ bar$$

$$W = \frac{P_2V_2 - P_1V_1}{1-n} = \frac{(2\ bar * 0.04m^3) - (0.607\ bar * 0.1m^3)}{1-1.3} = -0.0643\ bar.m^3 = -6.4KJ$$

# Extra notes:

# External Evaluator

## External Evaluator

The course-book is well organized, and it is a suitable learning for Third-stage students in the field of engineering automation industrial technology.

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