هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	Thermodynamics
Course Code:	PHYS 0262
Program:	BSc in Physics and BSc in Physics of Renewable Energy and Environment
Department:	Physics
College:	Science
Institution:	Majmaah University
Version:	1
Last Revision Date:	25/12/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3=3+0+0)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Year 2 / Level 4)					
4. Course General Description:					
The course introduces the fundamental principles governing energy, heat, and work. It investigates the first and second laws of thermodynamics as well as their applications in physical and engineering systems such as internal combustion engines, heat pumps, and refrigerators.					
5. Pre-requirements for this course (if any)**:**					
PHYS 0202 General Physics 2					
6. Co-requisites for this course (if any)**:**					
none					
7. Course Main Objective(s):					
By the end of the course, students should be able to: 1. Understand Fundamental Principles and clearly articulate the zeroth, first, second, and third laws of thermodynamics. 2. Explain the concepts of temperature, pressure, work, heat, and energy. 3. Apply Thermodynamic Laws 4. Solve problems involving energy conservation in closed systems using the first law of thermodynamics. 5. Analyze the efficiency and performance of heat engines, refrigerators, and heat pumps. 6. Evaluate State Functions and Processes. 7. Calculate changes in enthalpy, internal energy, and entropy during thermodynamic processes.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand and explain the zeroth, first, second, and third laws of thermodynamics.	**K1**	Interactive lectures Problem-Solving Sessions Case Studies Presentations Group Projects	Quiz Midterm Exams Homework Assignments Presentation Final Exam
1.2	Describe and calculate thermodynamic properties, such as energy, entropy, and enthalpy, for various systems.			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	Explain the physical significance of entropy and the implications of the second law of thermodynamics.	**K1**		
1.4				
2.0	**Skills**			
2.1	Solve problems related to thermodynamic processes and cycles	**S1**	Interactive lectures Problem-Solving Sessions Case Studies Presentations Group Projects	Quiz Midterm Exams Homework Assignments Presentation Final Exam
2.2	Apply thermodynamic principles to real-world systems like engines and refrigerators			
2.3	Evaluate the efficiency of systems using thermodynamic laws			
3.0	**Values, autonomy, and responsibility**			
3.1	Advocate for the adoption of hydrogen and fuel cell technologies as sustainable energy solutions.	**V2**	Interactive lectures Problem-Solving Sessions Case Studies Presentations Group Projects	Quiz Midterm Exams Homework Assignments Presentation Final Exam
3.2	Conduct research and critically evaluate emerging technologies in hydrogen production and fuel cell systems.			

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction: Definitions of thermodynamic terms, Closed and open systems, Reversible and irreversible processes, Pressure, Temperature, State equations for an ideal gas, Van der Walls gas, and other real gas.	6
2.	Work and Heat: Concept of work, Pressure-volume work, Other kinds of works, Heat capacity of solids, liquids, and gases, Latent heat, Constant volume, constant pressure, isothermal, adiabatic, and polytropic processes	9
3.	Internal energy: Concept of internal energy, Internal energy of an ideal gas, Enthalpy	6
4.	First law of thermodynamics: Energy conversions, Case of a closed system, Case of constant volume, constant pressure, isothermal, adiabatic, and polytropic processes, Cycle process, Application to Diesel, Otto, Carnot, Stirling, and Ericson cycles, Calorimetry	9
5.	Second Law of Thermodynamics and Concept of Entropy: Limitation of the first law, Thermal reservoir, heat engine, reversible and irreversible process, Carnot cycle, Carnot theorem, Entropy, processes, entropy change with a variable specific heat, Clausius Inequality, Clausius and Kelvin statement of the second law, Efficiency of engines, COP, Heat pumps and refrigerators.	9
6.	Thermodynamics potentials and Maxwell's relations: Internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy. Derivation and application of Maxwell's thermodynamic relations, Applications.	6
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Quiz**	**4**	**10**
2.	**Midterm Exam 1**	**6-7**	**15**
3.	**Midterm Exam 2**	**10-12**	**15**
4.	**Homework assignments**	**continue**	**10**
5.	**Presentation**	**12-15**	**10**
6.	**Final Exam**	**end**	**40**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Serway, Jewett - Physics for Scientists and Engineers with Modern Physics, 9th Ed
Supportive References	Physical chemistry, Thomas Engel, Philip J. Reid

	Thermodynamics: An Engineering Approach, Yunus A. Çengel and Michael A. Boles Fundamentals of Thermodynamics, Richard E. Sonntag, Claus Borgnakke, and Gordon J. Van Wylen
Electronic Materials	MIT OpenCourseWare: Thermodynamics and Kinetics NPTEL (National Programme on Technology Enhanced Learning)
Other Learning Materials	Research papers and case studies

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	Projector, smart board
Other equipment (depending on the nature of the specialty)	Internet. Library

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Internal Reviewer committee**	**Direct**
Effectiveness of Students assessment	**Faculty, Students**	**Direct (Exams, Rubrics), Indirect (Surveys)**
Quality of learning resources	**Students, Peer Reviewers**	**Indirect (Surveys)**
The extent to which CLOs have been achieved	**Faculty, Program Leaders**	**Direct (Exams, Rubrics)**
Other	**Students, Faculty, Alumni**	**Indirect (Questionnaires, Feedback Forms)**

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**16**
DATE	**30/12/2024**