Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	Erbil Technology College	
Department	AITE	
Module Name	Thermodynamics	
Module Code	THE505	
Degree	Technical Diploma [ ] Bachelor [x] 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)	Dr. Shelan M Mustafa	
E-Mail & Mobile NO.	Shelan.mustafa@epu.edu.iq	
Lecturer (Practical)	Dr. Shelan M Mustafa	
E-Mail & Mobile NO.	Shelan.mustafa@epu.edu.iq	
Websites		

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. 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.
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.

► Students are required to be on time for class, as late causes disruption for everyone.
Students with an absence rate over 10% by the end of the course will not be permitted to take the final exam.

► 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
Assignments	Homework	10%	3-14	1-6
	Class Activity	2%	3-13	1-6
	Report		3-14	
	Seminar	16%	7	1-6
	Project		3-13	
Quiz		8%	4&8&12	1-6
Lab.				
Midterm Exam		24%	8	
Final Exam		40%	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&2
Chapter#3: Evaluating Properties.	5&6	3,4&5
Chapter#4: Control Volume Analysis Using Energy.	7&8	3,4&5
Midterm Exam	9	
Chapter#5: The Second Law of Thermodynamics	10&11	5&6
Chapter#6: Entropy	11&12	5&6
Final exam preparation	13	
Final exam	14	

Questions Example Design

Ministry of Higher Education
& Scientific Research
Erbil Polytechnic University
Erbil Technology College
Department of AITE

Academic year: 2022 – 2023
Exam: Final/1st attempt

Class: Third , 5th Semester
Subject: Thermodynamics
Code:THE505
Time:2 Hours
Date: 18/ 12/2022

Q1/ 25 Mark

(A) From **Fig.1**, determine the specific volume of superheated water vapor at 10 MPa and 400 °C, using **(1)** the ideal-gas equation, **(2)** the generalized compressibility chart and **(3)** from the superheated steam table.(13M)

(B) Consider an electric refrigerator located in a room as shown in **Fig.2**. Determine the direction of the work and heat interactions (in or out) when the following are taken as the system:

1) the contents of the refrigerator.(4M)
2) all parts of the refrigerator including the contents.(4M)
3) everything contained within the room during a winter day.(4M)

Fig.1


Fig.2

Q2/ 25 Mark

Electric power as shown in **Fig.3** is to be generated by installing a hydraulic turbine–generator at a site 50 m below the free surface of a large water reservoir that can supply water at a rate of 5000 kg/s steadily. If the electric power generation is 1862 kW, determine overall efficiency, the turbine efficiency, and the shaft power of this plant. Neglect losses in the pipes and use gravitational acceleration g = 9.8 m/s^2.

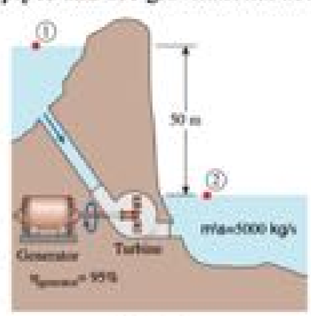


Fig.3

Q3/ 25 Mark

One kg of water vapor contained within a piston-cylinder assembly, initially at 400Kpa, 300°C, undergoes an **adiabatic** expansion to a state where pressure is 200 kpa and the temperature is **(a)** 300 °C, **(b)** 150 °C. Using the **entropy balance**, determine the nature of the process in each case.

Continue

Q4/ Answer only **five**.

25 Mark

For each question, answer (**T**) for true and (**F**) for false.

1. A gas in a piston-cylinder device is compressed, and as a result its temperature rises. It is a **heat** interaction.
2. A propane tank is filled with a mixture of liquid and vapor propane. The contents of this tank can be considered a **pure substance**.
3. A cold canned drink is left in a warmer room where its temperature rises as a result of heat transfer. It is a **reversible** process.
4. Non quasiequilibrium expansion process delivers **more** work than the corresponding quasi-equilibrium one.
5. Intensive is a thermodynamics property that is **independent** of size of system.
6. A piston–cylinder device contains helium gas. During a reversible, isothermal process, the entropy of the helium will **never** increase.
7. The entropy of steam will **increase** as it flows through an actual adiabatic turbine.
8. h_{fg} **decreases** with increasing pressure and becomes zero at the critical pressure.

Good Luck and Best Wishes

Dr. Shelan M. Mustafa
Lecturer

TABLE A-1

Molar mass, gas constant, and critical-point properties

Substance	Formula	Molar mass, M kg/kmol	Gas constant, R kJ/kg·K*	Critical-point properties: Temperature, K	Critical-point properties: Pressure, MPa	Critical-point properties: Volume, m^3/kmol
Air	—	28.97	0.2870	132.5	3.77	0.0883
Ammonia	NH_3	17.03	0.4882	405.5	11.28	0.0724
Argon	Ar	39.948	0.2081	151	4.86	0.0749
Benzene	C_6H_6	78.115	0.1064	562	4.92	0.2603
Bromine	Br_2	159.808	0.0520	584	10.34	0.1355
n-Butane	C_4H_{10}	58.124	0.1430	425.2	3.80	0.2547
Carbon dioxide	CO_2	44.01	0.1889	304.2	7.39	0.0943
Carbon monoxide	CO	28.011	0.2968	133	3.50	0.0930
Carbon tetrachloride	CCl_4	153.82	0.05405	556.4	4.56	0.2759
Chlorine	Cl_2	70.906	0.1173	417	7.71	0.1242
Chloroform	$CHCl_3$	119.38	0.06964	536.6	5.47	0.2403
Dichlorodifluoromethane (R-12)	CCl_2F_2	120.91	0.06876	384.7	4.01	0.2179
Dichlorofluoromethane (R-21)	$CHCl_2F$	102.92	0.08078	451.7	5.17	0.1973
Ethane	C_2H_6	30.070	0.2765	305.5	4.48	0.1480
Ethyl alcohol	C_2H_5OH	46.07	0.1805	516	6.38	0.1673
Ethylene	C_2H_4	28.054	0.2964	282.4	5.12	0.1242
Helium	He	4.003	2.0769	5.3	0.23	0.0578
n-Hexane	C_6H_{14}	86.179	0.09647	507.9	3.03	0.3677
Hydrogen (normal)	H_2	2.016	4.1240	33.3	1.30	0.0649
Krypton	Kr	83.80	0.09921	209.4	5.50	0.0924
Methane	CH_4	16.043	0.5182	191.1	4.64	0.0993
Methyl alcohol	CH_3OH	32.042	0.2595	513.2	7.95	0.1180
Methyl chloride	CH_3Cl	50.488	0.1647	416.3	6.68	0.1430
Neon	Ne	20.183	0.4119	44.5	2.73	0.0417
Nitrogen	N_2	28.013	0.2968	126.2	3.39	0.0899
Nitrous oxide	N_2O	44.013	0.1889	309.7	7.27	0.0961
Oxygen	O_2	31.999	0.2598	154.8	5.08	0.0780
Propane	C_3H_8	44.097	0.1885	370	4.26	0.1998
Propylene	C_3H_6	42.081	0.1976	365	4.62	0.1810
Sulfur dioxide	SO_2	64.063	0.1298	430.7	7.88	0.1217
Tetrafluoroethane (R-134a)	CF_3CH_2F	102.03	0.08149	374.2	4.059	0.1993
Trichlorofluoromethane (R-11)	CCl_3F	137.37	0.06052	471.2	4.38	0.2478
Water	H_2O	18.015	0.4615	647.1	22.06	0.0560
Xenon	Xe	131.30	0.06332	289.8	5.88	0.1186

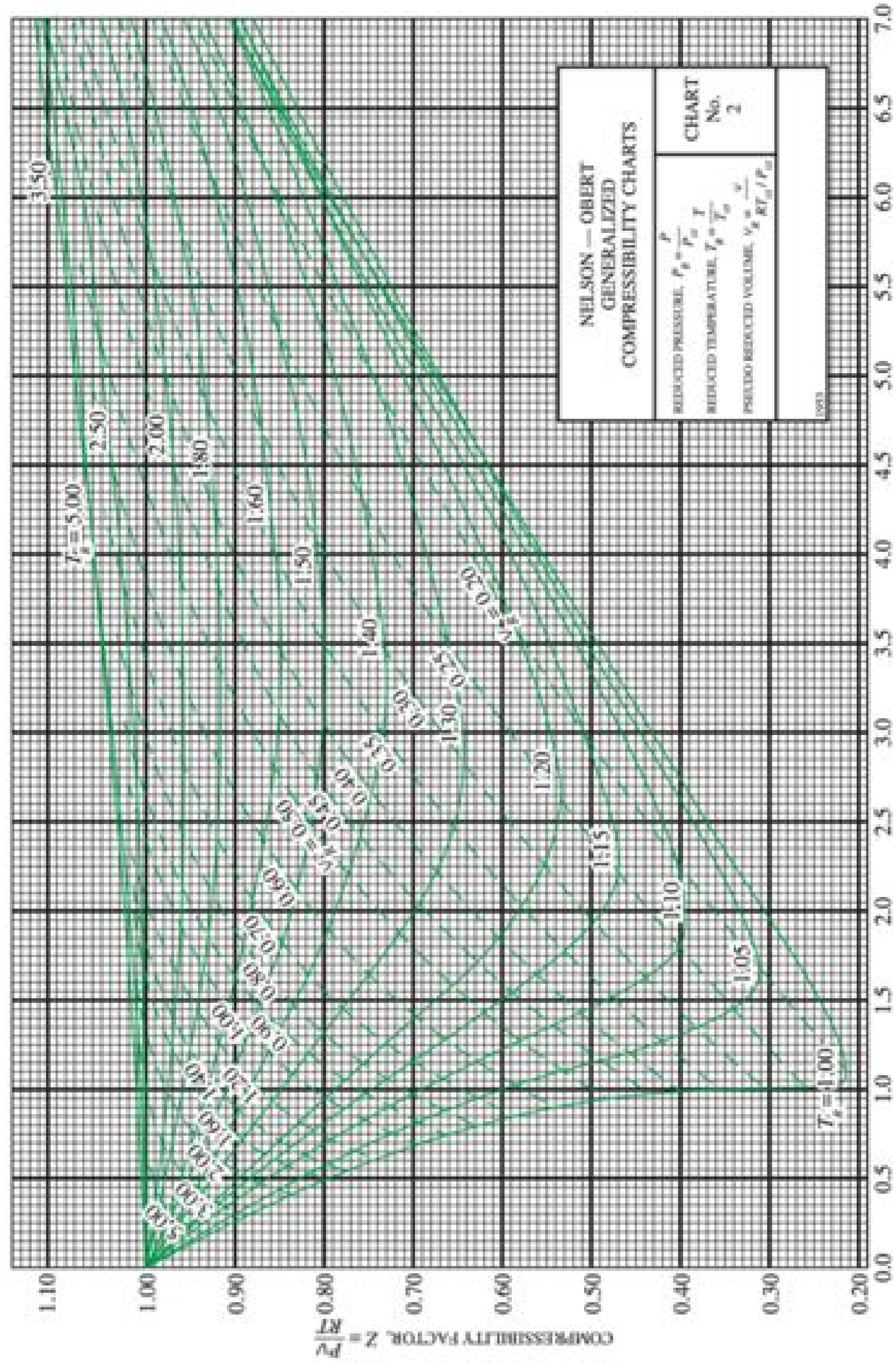
*The unit kJ/kg·K is equivalent to kPa·m³/kg·K. The gas constant is calculated from $R = R_u/M$, where R_u = 8.31447 kJ/kmol·K and M is the molar mass.

Source of Data: K. A. Kobe and R. E. Lynn, Jr., *Chemical Review* 52 (1953), pp. 117–236; and ASHRAE, *Handbook of Fundamentals* (Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1993), pp. 16.4 and 36.1.

TABLE A-6

Superheated water

T °C	v m^3/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m^3/kg	u kJ/kg	h kJ/kg	s kJ/kg·K	v m^3/kg	u kJ/kg	h kJ/kg	s kJ/kg·K
	P = 0.20 MPa (120.21°C)				P = 0.30 MPa (133.52°C)				P = 0.40 MPa (143.61°C)			
Sat.	0.88578	2529.1	2706.3	7.1270	0.60582	2543.2	2724.9	6.9917	0.46242	2553.1	2738.1	6.8955
150	0.95986	2577.1	2769.1	7.2810	0.63402	2571.0	2761.2	7.0792	0.47088	2564.4	2752.8	6.9306
200	1.08049	2654.6	2870.7	7.5081	0.71643	2651.0	2865.9	7.3132	0.53434	2647.2	2860.9	7.1723
250	1.19890	2731.4	2971.2	7.7100	0.79645	2728.9	2967.9	7.5180	0.59520	2726.4	2964.5	7.3804
300	1.31623	2808.8	3072.1	7.8941	0.87535	2807.0	3069.6	7.7037	0.65489	2805.1	3067.1	7.5677
400	1.54934	2967.2	3277.0	8.2236	1.03155	2966.0	3275.5	8.0347	0.77265	2964.9	3273.9	7.9003
	P = 9.0 MPa (303.35°C)				P = 10.0 MPa (311.00°C)				P = 12.5 MPa (327.81°C)			
Sat.	0.020489	2558.5	2742.9	5.6791	0.018028	2545.2	2725.5	5.6159	0.013496	2505.6	2674.3	5.4638
325	0.023284	2647.6	2857.1	5.8738	0.019877	2611.6	2810.3	5.7596				
350	0.025816	2725.0	2957.3	6.0380	0.022440	2699.6	2924.0	5.9460	0.016138	2624.9	2826.6	5.7130
400	0.029960	2849.2	3118.8	6.2876	0.026436	2833.1	3097.5	6.2141	0.020030	2789.6	3040.0	6.0433
450	0.033524	2956.3	3258.0	6.4872	0.029782	2944.5	3242.4	6.4219	0.023019	2913.7	3201.5	6.2749
500	0.036793	3056.3	3387.4	6.6603	0.032811	3047.0	3375.1	6.5995	0.025630	3023.2	3343.6	6.4651


NELSON — OBERT
GENERALIZED
COMPRESSIBILITY CHARTS
CHART No. 2
COMPRESSIBILITY FACTOR, Z = PV/RT

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.

Muhammed A. Ibrahim
Professor
Salahaddin University
Electronics and Communication Dep.
mabdulbaki@su.edu.krd

Course Book