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**Department of Physics**

**College of Science**

**Salahaddin University - Erbil**

**Subject: Heat & Thermodynamics**

 **General (II)**

**Course Book – (2 Year)**

**Lecturer's name: Dr. Hassan Sadi Ibrahim**

**Academic Year: 2021/2022**

**Course Book**

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| **1. Course name** | **Heat & Thermodynamics (II)** |
| **2. Lecturer in charge** | **Dr. Hassan Sadi Ibrahim**  |
| **3. Department/ College** | **Department of Physics / College of Science** |
| **4. Contact** | **e-mail: hassan.ibrahim@su.edu.krd****Tel: +9647507486600** |
| **5. Time (in hours) per week**  | **Theory: 3****Practical: 6**  |
| **6. Office hours** | **1** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **During the 13 years, experience teaching of different Subjects and Labs such as (Thermodynamics, Lab Solid state physics, Lab General Physics). Recently during the last year, I published a paper in Salahaddin University Journal, and also I was member in equalization commit of M.Sc. degree of abroad student****B.Sc. of Physics from 2003****M.Sc. Thermal Power from 2009****Ph. D of Solar System from 2012****Instructor Feb 2015 – up to date****Assist Prof. ………….** |
| **9. Keywords** | **Heat & Thermodynamics, Concepts and Applications****Origin of Thermodynamics, Postulate of Thermodynamics** |
| **10. Course overview:** Thermodynamics is the science of the conversions between heat and other forms of energy. It is an experimental science based on small number of principles that are generalization made from experience, and concerned only with macroscopic properties of matter. Thermodynamics is essential to understanding the principles behind engines, refrigerators, and even life itself.The course will give students a better understanding of the meaning of Heat and Temperature, begins by discussing some basic concepts and definitions and considering a scientific look at heat, temperature and internal energy and with a description of one of the laws of thermodynamics (“Zeroth law”). We then consider the law of conservation of energy as a universal law of nature, and the processes by which energy is transferred. Based on these concepts, the First law of thermodynamics with some of it is important applications will be discussed. The Heat Engines and their Efficiency, and then Carnot’s work to derive the maximum possibly efficiency of heat engines is presented. We will then look at how this leads to the concept of entropy and the Second law of thermodynamics, perhaps one of the most debated laws of physics. In addition, the kinetic theory will be given with an exploring how the various thermodynamic quantities, such as pressure, internal energy and temperature of a gas obeying basic classical physics. To conclude, we will look at some of the concepts such as reversibility, the principle of the maximum entropy. |
| **11. Course objective:**This course is designed to introduce the second year of bachelor student physics with the thermodynamics through course of lectures, problem-solving practice and discussion, which is considered one of the most important in classical physics. Objectives of the course can be represented as the following important points:1) Students will be familiar with the key concepts and most fundamental principles and their implication, especially the first and second laws of thermodynamics, and kinetic theory. 2) Students will be able to use and apply the basic concept of such as entropy, energy, heat, work, … etc. to a range of different thermodynamic systems in their daily life. For instance, air conditioner, refrigerator, power plant, etc. 3) This course will provide students with the fundamentals of phase transitions. The term of the phase transition is commonly used to describe transitions between solid, liquid and gaseous states of matter. Phase transitions are common occurrences observed in nature and many engineering techniques exploit certain types of phase transition. |
| **12. Student's obligation:**A list of additional useful problems will be given to help the student further sharpen your understanding of the subject and your problem solving skills. The students are required to do these problems, although you may find it useful to do so. Because this subject is One course, so that the students are required to do at least tow closed exam during this semester besides other assignments and each student must prepare full report at the end of the year. All exams have marks, full report also has marks, the classroom activities count marks and mark for attendance too. لێره‌ مامۆستا به‌رپرسیارێتی قوتابی ڕوونده‌کاته‌وه‌ سه‌باره‌ت به‌ کۆرسه‌که‌ بۆ نموونه‌ ئاماده‌بوونی قوتابیان له‌ وانه‌کاندا، له‌ تاقیکردنه‌وه‌کاندا، راپۆرت و ووتار نووسین... هتد.  |
| **13. Forms of teaching**Different types of teaching will be used to reach the objective of the subject: - power point, video, and different animation flash for all subject of thermodynamic subject.لێره‌ مامۆستا ڕێگه‌ی وانه‌‌ ووتنه‌وه‌ ده‌نووسێت، بۆ نموونه‌:‌ داتاشۆ و پاوه‌رپۆینت، ‌سه‌ر ته‌خته‌ڕه‌ش، ته‌خته‌ی سپی، سمارتبۆرد یان‌ مه‌لزه‌مه‌... هتد |
| **14. Assessment scheme**All exams have 30 marks, full report has 5 marks, the classroom activities count and for attendance 5 Marks. So that the final grade will be based upon the following criteria:Mid- semester exam: 30%Classroom participation and assignments: 5%Report: 5%Final Exam: 60%.Breakdown of overall assessment and examinationلێره‌ مامۆستا جۆری هه‌ڵسه‌نگاندن (تاقیکردنه‌وه‌کان یان ئه‌زموونه‌کان) ده‌نووسێت بۆ نموونه‌ تاقیکردنه‌وه‌ی مانگانه‌، کویزه‌کان، بیرکردنه‌وه‌ی ڕه‌خنه‌گرانه (پریزه‌نته‌یشن)، ڕاپۆرت نووسین، ووتار نووسین‌ یان ئاماده‌نه‌بوونی قوتابیان له‌ پۆلدا...هتد. ئامانه‌ چه‌ند نمره‌ی له‌سه‌رده‌بێت و مامۆستا چۆن نمره‌کان دابه‌شده‌کات؟‌ |
| **15. Student learning outcome:**Thermodynamics plays a very important role in the Physics field, during the years I teaching Thermodynamics, I have notices that students generally find it easier to learn its underlying ideas than to handle the practical aspects of the formalism. What is true is that the students at the Physics department who were all selected after a stiff entrance examination, and whose ambitions in life were diverse – in science, in industry, in business– all had to follow this introductory physics course. As a consequence, the challenge was to try to get them interested in the field whatever their future goals were. Of course, quantum mechanics is an ideal subject because one can be interested in it for a variety of reasons, such as the physics itself, the mathematical structure of the theory, its technological spinoffs, as well as its philosophical or cultural aspects. So the task was basically to think about the pedagogical aspects, in order to satisfy audiences that went up to many students during the last 10 years.پڕکردنه‌وه‌ی ئه‌م خانه‌یه‌ زۆر گرنگه‌، مامۆستا ده‌رئه‌نجامه‌کانی فێربوون ده‌نووسێت. بۆ نموونه‌: ڕوونی ئامانجه‌ سه‌ره‌کیه‌کانی کۆرسه‌که‌ (بابه‌ته‌که‌) بۆ خوێندکار‌گونجاندنی ناوه‌ڕۆکی کۆرسه‌که‌ به‌ پێویستی ده‌ره‌وه‌ و بازاڕی کارقوتابی چی نوێ فێرده‌بێت له‌ ڕێگه‌ی پێدانی ئه‌م کۆرسه‌وه‌؟This should not be less than 100 words  |
| **16. Course Reading List and References‌:****Books**: *There are many good introductory texts on Thermodynamics for example:* * "Heat And Thermodynamics" 2002, by Brij Lal & N. Subrahmanyam.
* "Heat Thermodynamics and Statistical Physics". 2000. by S.Chand
* "Heat And Thermodynamics" (“Seventh Edition”). 1997, by Mark W. Zemansky. & Richard H. Dittman
* "Engineering Thermodynamics". 2010, by Tarik Al-Shemmeri & Ventus Publishing

الحرارة والثرموداينميك : د اسامي مظلوم د امجد كرجية (1988)الحرارة والثرموداينميك : د هاشم قاسم عبود (1980) ▪ Key references:▪ Useful references:▪ Magazines and review (internet): |
| **17. The Topics:** | **Lecturer's name** |
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| Subject | Week |
| Average kinetic energy of the molecule, P – V – T Surface of Ideal Gas, Van Der Waal's equation and critical constant, Compressibility Factor. | 1 |
| Andrew's Experimental for CO2 Gas, Comparison theoretical and experimental PV curve, Boyle’s temperature, Behaviour of gases at high pressure | 2 |
|  P-V-T Surface of Real gas, Phase of matter, Phase of diagram, Specific heat, Heat capacity. | 3 |
| Calorimeter, Latent Heat of Fusion and Vaporization, Laws of Fusion and boiling, Change of state of substance, Saturated vapor pressure, Saturated vapor and saturated liquid | 4 |
| Zero law of thermodynamic, Concept of Heat, Work: - A path dependent function, Internal Energy (U). First law of thermodynamic. | 5 |
| The relation between heat and work, Kinds of thermodynamic process in First law, Work done of different process. | 6 |
|  Heat Capacity Of an Ideal Gas, Relation between (Cp, Cv and γ), Degree of freedom. | 7 |
| Specific heat of gases, Enthalpy, The Coefficient of volume Expansion and Compression of Van-Der-Walls gas | 8 |
| Heat Engine, Otto Cycle, Efficiency of Gasoline engine. | 9 |
| Second Law Of Thermodynamics, Statements of Second Law of Thermodynamics, Kelvin- Planck Statement, The Clausius Statement. | 10 |
| Heat pumps and Refrigerators, Carnot cycle, Efficiency of Carnot cycle. | 11 |
| Entropy and Third law of Thermodynamic, The property of Entropy, Entropy of ideal gas, Entropy heat engine. | 12 |

 | Dr. Hassan Sadi Ibrahim ex: (3 hrs.) ex: 01/02/2015 |
| **18. Practical Topics (If there is any)** |  |
| In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture  | Lecturer's name: Dr. Hassan Sadi Ibrahim ex: (3 hrs.)ex: 01/02/2015 |
| **19. Examinations:**Q1/ Choose the correct statements1- Which of the following specific temperatures are defined in terms of vapor pressure?a) Boiling point c) Decomposition temperatureb) Melting point d) Critical mass2- A Carnot engine takes 3 × 106 cal. of heat from a reservoir at 627 °C and gives it to a sink at 27 °C. The work done by the engine is a) Zero b) 4.2 × 106 J c) 8.4 × 106 J d) 16.8 × 106 J=3- In an adiabatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.  (a) q=0, ∆T≠0, w=0 (b)  q≠0, ∆T=0, w=0  (c) q=0, ∆T=0, w=0 (d)  q=0, ∆T<0, w=0 Q2/ Fill the following blank with possible word:-1. The rate of heat flow by the wall of cylindrical tube ……………………
2. solar spectrum range of wavelengths includes ……. , ……… , and …………..
3. emissivity is dimensionless number between …….. and ……

Q3/ **)** Explain briefly following with draw if is necessary: 1. Behavior of gases at high pressure.
2. Various Statements of Second Law.
3. Change of State for Water

Q4/ Could you have γ < 1, where [γ = CP / CV]? Explain. |
| **20. Extra notes:**Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks. |
| **21. Peer review پێداچوونه‌وه‌ی هاوه‌ڵ** This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*ئه‌م کۆرسبووکه‌ ده‌بێت له‌لایه‌ن هاوه‌ڵێکی ئه‌کادیمیه‌وه‌ سه‌یر بکرێت و ناوه‌ڕۆکی بابه‌ته‌کانی کۆرسه‌که‌ په‌سه‌ند بکات و جه‌ند ووشه‌یه‌ک بنووسێت له‌سه‌ر شیاوی ناوه‌ڕۆکی کۆرسه‌که و واژووی له‌سه‌ر بکات.هاوه‌ڵ ئه‌و که‌سه‌یه‌ که‌ زانیاری هه‌بێت له‌سه‌ر کۆرسه‌که‌ و ده‌بیت پله‌ی زانستی له‌ مامۆستا که‌متر نه‌بێت.‌‌  |