**《工程热力学》教学大纲（Syllabus）**

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| **课程代码**  **（Course Code）** | 03011020 |
| **课程名称**  **（Course Title）** | 工程热力学 |
| Engineering Thermodynamics |
| **课程性质**  **(Course Identification)** | 工程热力学是热能工程、制冷、工程热物理、热能动力工程、建筑环境与设备等专业的一门主要的大类学科基础课。  Engineering Thermodynamics is a fundamental and common course for following professional subjects including thermal energy engineering, refrigeration, engineering thermal physics, thermal energy and power engineering, building environment and equipment engineering, etc. |
| **学分/学时**  **(Credits /Hours)** | 4学分 / 64学时  4 Credits/64 Hours |
| **开课学期**  **(Semester)** | 二（2）  2nd year undergraduate, 2nd semester |
| **开课单位**  **(School/Department)** | 能源与环境学院  School of Energy and Environment |
| **适用专业**  **(Specialty)** | 能源与动力工程、建筑环境与设备工程，核科学与工程  Energy and Power Engineering, building environment and equipment engineering， nuclear science and engineering |
| **教学语言**  **(Teaching language)** | 演示文稿、讲解、作业、试卷均采用中文，术语采用中英文对照；或者采用全英文  Brief，presentation，assignment，exam in Chinese，technical terms in both Chinese and English; or full English. |
| **先修课程**  **(Prerequisite Courses)** | 高等数学、大学物理  **Higher Mathematics, College Physics** |
| **后续课程**  **(Follow - up Courses)** | 燃气轮机与热电联产  Gas turbine and thermal electricity co-generation |
| **教材及参考书**  **(Textbooks and Reference books)** | * 华永明. 工程热力学. 中国电力出版社，2013.9 * [Yunus A. Cengel](http://www.amazon.co.uk/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Yunus+A.+Cengel&search-alias=books-uk&text=Yunus+A.+Cengel&sort=relevancerank), [Michael A. Boles](http://www.amazon.co.uk/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Michael+A.+Boles&search-alias=books-uk&text=Michael+A.+Boles&sort=relevancerank). Thermodynamics: An Engineering Approach (seventh edition), McGraw-Hill Higher Education, 2010.3. * 严家騄，王永青.工程热力学(第二版). 中国电力出版社，2007.09. |
| **课程简介**  **（Course Introduction）** | 工程热力学在阐述物质的能量、能量转化以及能量和物质性质之间的关系的基础上，研究热能转化为机械能的规律和方法、提高转化效率的途径以提高能源利用的经济性。本课程在介绍基本概念的基础上，重点关注热力学第一、第二定律，工质性质，并探讨常见热力过程和热力循环。  The fundamentals of Engineering Thermodynamics need to be understood by anyone who hopes to make a career in the areas including but not limited to thermal engineering, refrigeration, engineering thermal physics, thermal and power engineering, architectural environment and equipment engineering, etc. The overall objective of this course is to enable the students to apply the basic principles in thermodynamics to help analyzing and solving the practical problems relating to energy transferring between thermal energy and mechanical energy. |
| **考核方式**  **（Evaluation Method）** | * 每周作业 10% * 期中考试 0% * 期末考试 90% * Weekly assignment: 10% * Midterm exam: 0% * Final exam: 90% |
| **实验教学**  **（Experimental Teaching）** | 无  N/A |
| **专业培养能力**  **（Training for Professional Abilities）** | （5）具有对于能源与动力工程问题进行系统表达、建立模型、分析求解和论证的能力。  （6）具备进行能源动力系统及装置工程设计、运行控制、故障诊断、失效分析的能力。  （10）掌握热与流体、能源转换与利用、污染物排放与控制、噪声与振动等方面的基本理论和基本知识。  （11）掌握能源动力系统与装置系统表达，设计制造、运行控制、故障诊断、失效分析等方面的基本理论和基本知识  (5) ability to systematically expression, modelling, analyzing and verification in the energy and power engineering area;  (6) ability to the engineering design of system and facility, operation and control, problem shooting and failure analysis in energy and power engineering area;  (10) grasp the basic theory and knowledge in heat and flow, energy transfer and utilization, pollutant emission and control, noise and vibration;  (11) grasp the basic theory and knowledge in systematically expression, design and manufacturing, operation and control, problem shooting and failure analysis. |
| **课程培养学生的能力**  **(Training for Students’ Abilities)** | 1.分析问题: 针对本课程基本概念多、系统性强、基本原理应用灵活的特点,主要加强学生对热力学基本理论的理解和培养对工程中常见的具体热工问题的分析能力的培养。（5,6）  2.工程计算和表达能力:要求学生的作业要条理清晰、使用公式正确、使用的符号及单位规范、应用图表查取的数据准确、且计算结果可靠,以此来培养学生的工程计算能力和表达能力。（5,6,10,11）  3.自学能力和创新能力的培养: 平时加强学生对本课程解决问题的宏观方法的训练,通过有针对性的教学内容,培养学生注意阶段性的知识整理、归纳和消化能力。培养学生独立思考和深入钻研问题的习惯。（5,6,11）  1. Problem analysis: Coping with the characteristic of multi-conceptual, systematical and flexible, the course will address on the understanding of basic concept of thermodynamics and will focus on solving the common and specific issues encountered in the practice; (5,6)  2. Engineering calculation and expression: a clear outline, correct equation application, correct symbol and unit utilization, data acquisition based on chart and table reading, result double check, etc. are required.  3. Self-education and innovation ability: enhance the practice training on problem-solving method, strength the ability of knowledge acquirement, knowhow, self-thinking and deep investigation. |
| **教学内容与**  **学时分配**  **（Teaching Content and**  **Hours Allocation）** | 教学内容包含绪论、热力学基本概念、热力学第一定律、热力学第二定律、工质性质、热力工程、气体的流动和压缩、热力循环和制冷循环，其中：  1、绪论和热力学基本概念（5学时/课内）  了解工程热力学的研究对象和研究方法。  掌握热力学的基本术语和概念(热力系、平衡态、准静态过程、可逆过程等)。掌握状态参数的特征及基本状态参数*p、T、v*的定义和单位。  2、热力学第一定律（8学时/课内）  掌握能量、储存能、热力学能和迁移能的概念和计算。深入理解热力学第一定律的实质,熟练掌握热力学第一定律及其表达式。能够正确、灵活地应用热力学第一定律表达式分析计算工程实际中的相关问题。  3、热力学第二定律（10学时/课内）  认识能量不仅有“量”的多少,而且还有“质”的高低,掌握卡诺定理的内容及使用条件。掌握孤立系和绝热系熵增的计算,明确熵的产生与能量损耗之间的关系和计算方法。了解可用能的概念及其计算方法。了解热力学第二定律对工程实践的指导意义。  4、工质性质：理想气体和实际气体、蒸汽、湿空气（11学时/课内）  熟练掌握理想气体状态方程式。正确理解比热容的概念,熟练掌握用比热容计算热量的方法。熟练掌握理想气体的热力学能、焓和熵的变化量的计算。了解实际气体状态方程和范德瓦尔方程。了解对比态原理,会计算对比参数并能利用通用压缩因子图进行实际气体的计算。讨论：信号采集与信号处理，结合项目设计进行。  掌握有关蒸汽的各种术语及其意义。了解蒸汽定压发生过程的规律和各热力状态的特点。了解水蒸气表和图的结构组成,熟练应用图或表查取未知状态参数。掌握水蒸气热力过程中热量和功量的计算。  5、热力过程（5学时/课内）  熟练掌握4个基本热力过程以及多变过程的初、终基本状态参数之间的关系。熟练掌握各过程中系统与外界交换的热量和功量的计算。能将各过程表示在p-v图和T-s图上,并能正确地应用p-v图和T-s图判断过程的特点,及及*w*等的正负值。  6、气体的流动和压缩（11学时/课内）  掌握稳定流动的基本方程。了解促使流速改变的力学条件和几何条件,以及这两个条件对流速的影响。掌握喷管中气体流量和流速的计算,会进行喷管外形的选择和尺寸计算,以及有摩阻时喷管出口参数的计算。理解滞止焓、临界截面各参数的概念。掌握绝热滞止、绝热节流的计算。  了解压气机的工作原理,掌握不同压缩过程中状态参数的变化规律和耗功的计算。了解多级压缩、级间冷却的工作过程和余隙容积对活塞式压气机工作的影响。  7、热力循环（9学时/课内）  了解各种循环的实施设备及工作流程。掌握将实际循环抽象和简化为理想循环的一般方法,并能分析各种循环的热力过程组成。掌握各种循环的吸热量、放热量、作功量及热效率的计算方法。会分析影响各种循环经济性指标的主要因素,掌握提高各种循环能量利用经济性的具体方法和途径。  8、**制冷循环 （5学时/课内）**  掌握常见制冷循环的工作过程、吸热量、放热量、做功量和制冷系数的计算。  1. introduction and basic concept of thermodynamics (5Hours/Class)  To understand the research object and research method;  2. first law of thermodynamics (8Hours/Class)  To grasp the first law of thermodynamics: the basic concept and calculation of energy forms and energy conversion ;  3. second law of thermodynamics (10Hours/Class)  To grasp the second law of thermodynamics: use it to analyze the practical problems;  4. property of working medium (11Hours/Class)  To grasp the property of ideal gas, calculation of the normal gas processes;To grasp the property of the steam, the diagram of the enthalpy and entropy (H-S diagram) and the calculation of the steam processes; To grasp the property of the wet air (air/steam mixture), the basic concepts and the calculation of the normal wet air processes;  5. thermal process (5Hours/Class)  To grasp the four basic thermal process and relationship between the starting and ending points; to grasp the calculation of work and heat; able to draw the thermal process on P-v and T-s diagram;  6. gas flow and compression (11Hours/Class)  To grasp the basic equations of stable flow. Know how the calculate the velocity by changing the mechanical context and geometry condition; know how to select the nozzle and design the nozzle. Understand the working principle of gas compressor, grasp how to calculate the parameter variation and work/heat in a compression process; understand the working principle of multi-stage compressor.  7. Thermal cycles (9Hours/Class)  To grasp the concept and calculation of the important cycles: Carnot cycle, Rankie Cycle, Gas power cycle, refrigeration cycle.  8. refrigeration cycle (5Hours/Class)  To grasp the process, heat absorption, hear extraction work and refrigeration ratio of refrigeration cycle. |
| **教学方法 （Teaching Method）**  **必填** | 课程教学以课堂教学、课外作业、综合讨论以及结合授课教师的科研项目进行案例教学等共同实施。  本课程通过授课与讨论、结合工程实践重点培养学生的基础知识和基本技能、思考和分析问题的能力、并理论应用于实践的能力。  本课程的教学将充分利用数字化技术、网络技术制作丰富多彩的教学和辅导材料，调动学习积极性，提高教学效率。本课程注重教与学过程，采用每周作业、专题研讨和考试等多种形式综合考核。  Course teaching includes class teaching, spare time assignment, discussion and case study based on research projects.  Development on the basic knowledge and basic skills of students, thinking and analysis ability, and capacity of applying the theory on engineering practice.  To foster the teaching efficiency, various technologies including the virtue technology, internet technology and information technology will be employed to stimulate the study enthusiasm of students. Multi ways of assessment including assignment, group discussion and examination will be utilized. |
| **制定人**  **及发布时间**  **（Developers**  **and Release Time）** | Lunbo Duan，2015年 05月05日 |

**实验课程教学大纲模板：**

**Experimental Course Syllabus Template:**

**《课程名称》实验教学大纲**

**“XXXXXX” Syllabus**

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| **课程名称**  **(Course Title)** |  | | |
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| **总学时**  **(Total Hours)** |  | **学分(Credits)** |  |
| **理论学时**  **(Theoretical Hours)** |  | **实验学时(Experimental Hours)** |  |
| **开课单位**  **(School/Department)** |  | | |
| **适用专业**  **(Specialty)** |  | | |
| **先修课程**  **(Prerequisite Courses)** |  | | |
| **课程简介**  **（Course Introduction）** |  | | |
| **教学目标**  **与要求**  **(Teaching Objectives**  **& Requirements)** |  | | |
| **主要仪器设备**  **(Major Instrument Equipments)** |  | | |
| **专业培养能力**  **（Training for Professional Abilities）** |  | | |
| **课程培养学生的能力**  **(Training for Students’ Abilities)** |  | | |
| **考核及成绩评定方式与要求**  **(Assessment and Evaluation Methods and Requirements)** | **实验报告(Experimental Report)：** | | |
| **考核(Assessment)：** | | |
| **实验教材、指导书及其他学习资源**  **(Experimental Materials, Instruction Books and other Learning Resources)** |  | | |
| **制定人**  **及发布时间**  **(Developers**  **and Release Time)** |  | | |