

# 확장형 수업계획서 (Extended Syllabus)

<b>과목명</b>	열역학1	<b>학기</b>	2018학년도 1학기
<b>구분(학점)</b>	3학점	<b>과목번호</b>	MEE2022
<b>수업시간</b>	미정	<b>수강대상</b>	기계공학전공 2학년

	성명: 김대중	홈페이지:
	_____	
	면담시간: 추후 공지	

## I. 교과목 개요(Course Overview)

### •수업개요

The course will consider the fundamental science of classical thermodynamics and its practical applications. Problem solving will be emphasized, including problem formulation and analytic solutions. Topics include:

- Some introductory comments: some definitions, some history, some philosophy, relevance of thermodynamics to engineering applications,
- Concepts: property, state, system, process, temperature, pressure, density, volume, energy, units, zeroth law of thermodynamics,
- Properties of a pure substance: vapor/liquid/solid phase equilibrium, independent properties, thermal equation of state, tables of properties, ideal gas limit, interpolation,
- Work and heat: some mathematics, simple compressible systems, work, heat,
- The first law of thermodynamics: classical formulation of the first law, internal, kinetic, and potential energy, enthalpy, constant pressure and constant volume specific heats, tables of energy and enthalpy, constant and temperature-dependent specific heats for ideal gases, time-dependency,
- First law analysis for a control volume: detailed derivations, control volume mass conservation, first law formulation for control volume, steady-state processes, transient processes, devices,
- The second law of thermodynamics: statements of the second law, heat engines and refrigerators, reversible processes, absolute temperature scale, Carnot cycles
- Entropy: theoretical development, second law in terms of entropy, the Gibbs equation, entropy for ideal gases, entropy change for reversible and irreversible processes, tabulation of entropy, adiabatic reversible processes for ideal gases, entropy of mixing, probabilistic approach, and
- Second law analysis for a control volumes: irreversible entropy production, Bernoulli's principle, steady state and transient formulation, efficiency of components.

•선수학습내용

필수 선수과목 없음

(일반물리학이나 일반화학의 내용이 도움은 됨)

•수업방법

강의	토의/토론	실험/실습	현장학습	개별/팀 별 발표	기타
100%	%	%	%	%	%

•평가방법

중간고사	기말고사	퀴즈	발표	프로젝트	과제물	참여도	기타
30%	50%	10%	%	%	10%	%	%

## II. 교과목표(Course Objectives)

•지식:

1. Students must understand the closed system and open system/control volume concepts and be able to describe engineering problems in terms of these concepts.
2. Students must understand the concepts of an equation of state and be able to use such an equation to describe pure substances. This includes understanding and being able to apply various property tables.
3. Students must understand the first and second laws of thermodynamics and learn how to apply these laws to both open and closed systems.
4. Students must understand how materials store energy and the relationship between the energy storage and phase changes in materials.

•기술:

1. Students must know how to use all the thermodynamic tables, e.g. steam tables, property tables for different types of refrigerants.
2. Students must know how to use computerized software, e.g. computer-aided thermodynamics table (CATT3).
3. Student must know how to analyze practical devices from the thermodynamic point of view.

•태도:

1. Students must be prepared for the thermodynamic applications including power plants, refrigeration systems, heat pumps, pumps, compressors, turbines, nozzles, diffusers, internal combustion engines, gas turbine engines.

## III. 수업운영방식(Course Format)<sup>(\* I -3의 수업방법의 구체적 설명)</sup>

- 강의: 100%
  - 이론 강의: 화요일

- 문제 풀이: 목요일

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#### IV. 학습 및 평가활동(Course Requirements and Grading Criteria)

- 평가: 퀴즈, 중간고사, 과제물, 기말고사를 위의 반영비율에 따라 산정된 weighted sum을 기준으로 아래와 같은 퍼센트로 상대평가 실시

- A's: 상위 30%(+, 0,-를 가급적 1/3씩 부여, 그러나 A+는 일등 학생에게 부여될 수도 없을 수도 있음)

- B's: 상위 31%~70%(+, 0,-를 가급적 1/3씩 부여)

- C's: 상위 71%~90%(+, 0,-를 가급적 1/3씩 부여)

- D's: 하위 10%(+, 0,-를 가급적 1/3씩 부여)

- 퀴즈, 중간/기말고사, 과제물 중 하나라도 0점인 경우 다른 평가요소에 무관하게 F 부여.

- 기한을 넘긴 과제물에 대한 penalty

- 30% penalty within 24 hr

- 50% penalty within 48 hr

- 70% penalty within 72 hr

- No point after 72 hr

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- ~~교과기반 글쓰기 과제/활동 예: 보고서, 토론, 발표과제 등 수업에서 제시되는 모든 글쓰기 활동~~

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#### V. 수업규정(Course Policies)

- 출결 규정

- 대학에서 정한 규정을 따르며 예외 인정하지 않음.

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- 시험 채점 관련

- 정답의 수치에서 1% 이상 오차가 있는 경우 해당 문제는 영점 처리.

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- 질의응답 관련

- 강의 시간 내의 질문에만 대답할 것임.

- 개인 적인 질문은 대응하지 않음.

- 기한을 넘긴 과제물에 대한 penalty
  - 30% penalty within 24 hr
  - 50% penalty within 48 hr
  - 70% penalty within 72 hr
  - No point after 72 hr
- 시험 관련 사항
  - 각 시험에 대한 채점이 종료된 후 점수를 조교 연구실 앞에 평균/표준편차와 함께 학번순으로 정렬해서 공지할 것임.
  - 각 시험의 정답과 각자의 답안지는 조교에게 회람 가능: 족보 유출 방지를 위해 답안지의 조교 연구실 외부 반출은 금지됨(족보는 그 유무에 따라 시험의 공정성을 해치는 요인이므로 기출문제 유출에 대비한 조치를 취할 것임).

## VI. 교재 및 참고문헌(Materials and References)

- 필수 교재
  - C. Borgnakke and R. E. Sonntag, "Fundamentals of thermodynamics," 8th edition, John Wiley and Sons, Inc.
 (수많은 오역 때문에 번역본 사용은 비권장)
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- 참고 서적
  - (모든 학부 수준 공학열역학 서적, 특히 아래 서적, 필수 교재를 포함한 아래 서적은 도서관에서 지정 도서로써 본 교과 수강생만 대여 가능)
  - T. A. Cengel and M. A. Boles, "Thermodynamics: An Engineering Approach," 7th edition in SI units, McGraw-Hill.
  - M. J. Moran and H. N. Shapiro, "Fundamentals of thermodynamics," 6th edition, John Wiley and Sons, Inc.
  - S. R. Turns, "Thermodynamics: Concepts and Applications," Cambridge. -

## VII. 주차별 수업계획(Course Schedule)(\* 추후 변경될 수 있음)

- 1주차 (03월 06일, 03월 08일)
  - 학습목표: To be exposed to the science of thermodynamics
  - 주요학습내용: The basic concepts of thermodynamics are introduced and discussed.

Thermodynamics is the science that primarily deals with energy. Interesting examples of thermodynamic systems are described, e.g. power plants, fluid machinery, refrigeration systems.

- 수업방법: 강의 100%
- 수업자료: Chap. 1 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•2주차 (03월 13일, 03월 15일)

- 학습목표: To be exposed to the terminology and concepts of thermodynamics and several basic thermodynamic properties

- 주요학습내용: A system of fixed mass is called a closed system, or control mass, and a system that involves mass transfer across its boundaries is called an open system, or control volume. The mass-dependent properties of a system are called extensive properties and the others intensive properties. Density is mass per unit volume, and specific volume is volume per unit mass. The normal force exerted by a fluid per unit area is called pressure.

- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 2 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions (1차 과제물 공지-상세 내용 추후 공지)

•3주차 (03월 20일, 03월 22일)

- 학습목표:
- 주요학습내용:
- 수업방법: 이론 강의 및 문제 풀이(일단 퀴즈 예정 그러나 변동 가능)
- 수업자료: Chap. 3 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•4주차 (03월 27일, 03월 29일)

- 학습목표: To learn how to obtain the properties of pure substances and to further understand the concept of work

- 주요학습내용: In a saturated liquid–vapor mixture, the mass fraction of vapor is called the quality. Any relation among the pressure, temperature, and specific volume of a substance is called an equation of state. Work is the energy transferred as a force acts on a system through a distance. The most common form of mechanical work is the boundary work, which is the work associated with the expansion and compression of substances.

- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 3 and Chap. 4 of Borgnakke and Sonntag (roughly first half)
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions (2차 과제물 공지-상세 내용 추후 공지)

•5주차 (04월 04일, 04월 06일)

- 학습목표: To further understand the concept of heat and to summarize the progress at this point
- 주요학습내용: Energy can cross the boundaries of a closed system in the form of heat or work. For control volumes, energy can also be transported by mass. If the energy transfer is due to a temperature difference between a closed system and its surroundings, it is heat; otherwise, it is work.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 4 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•6주차 (04월 11일, 04월 13일)

- 학습목표: To understand the first law of thermodynamics
- 주요학습내용: The first law of thermodynamics is essentially an expression of the conservation of energy principle, also called the energy balance. The amount of energy needed to raise the temperature of a unit mass of a substance by one degree is called the specific heat at constant volume for a constant-volume process and the specific heat at constant pressure for a constant-pressure process.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 5 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•7주차 (04월 18일, 04월 20일)

- 학습목표: To apply the first law of thermodynamics to control mass and to be exposed to the first law for control volume
- 주요학습내용: Control mass examples of the first law applications are introduced. The conservation of mass principle states that the net mass transfer to or from a system during a process is equal to the net change (increase or decrease) in the total mass of the system during that process.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 5 and Chap. 6 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions (3차 과제물 공지-상세 내용 추후 공지)

•8주차 (04월 25일, 04월 27일)

(중간고사 기간: 수업 없음, 본 교과목 중간고사 일시는 추후 공고)

- 학습목표:
- 주요학습내용:
- 수업방법:
- 수업자료:
- 과제:

•9주차 (05월 01일, 05월 03일)

- 학습목표: To further understand and apply the first law for control volume
- 주요학습내용: In the analysis of control volumes, it is convenient to combine the flow energy and internal energy into enthalpy. Control volume examples of the first law applications are introduced.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 6 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•10주차 ( 05월 08일, 05월 10일)

- 학습목표: To be exposed to the second law of thermodynamics
- 주요학습내용: The second law of thermodynamics states that processes occur in a certain direction, not in any direction. A process does not occur unless it satisfies both the first and the second laws of thermodynamics.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 7 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions (3차 과제물 공지-상세 내용 추후 공지)

•11주차 ( 05월 15일, 05월 17일)

- 학습목표: To understand the concept of heat engines and refrigerators and the Kelvin-Planck and Clausius statements
- 주요학습내용: Work can be converted to heat directly, but heat can be converted to work only by some devices called heat engines. Refrigerators and heat pumps are devices that absorb heat from low-temperature media and reject it to higher-temperature ones. The Kelvin-Planck statement of the second law of thermodynamics states that no heat engine can produce a net amount of work while exchanging heat with a single reservoir only. The Clausius statement of the second law states that no device can transfer heat from a cooler body to a warmer one without leaving an effect on the surroundings.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 7 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•12주차 ( 05월 22일, 05월 24일)

- 학습목표: To understand the Carnot cycles and the concept of entropy
- 주요학습내용: A heat engine that operates on the reversible Carnot cycle is called a Carnot heat engine. The Carnot cycle efficiency is the maximum efficiency a heat engine operating between two reservoirs. The second law of thermodynamics leads to the definition of a new property called entropy, which is a quantitative measure of microscopic disorder for a system.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 7 and Chap. 8 of Borgnakke and Sonntag

- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•13주차 ( 05월 29일, 05월 31일)

- 학습목표: To understand the second law in terms of entropy and to learn how to calculate entropy
- 주요학습내용: The inequality part of the Clausius inequality combined with the definition of entropy yields an inequality known as the increase of entropy principle. The entropy-change and isentropic relations for a process are given in the analytical forms.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 8 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•14주차 ( 06월 05일, 06월 07일)

- 학습목표: To learn how to apply the second law to real engineering systems
- 주요학습내용: Various engineering systems are analyzed in terms of the first and second laws of thermodynamics. Various engineering systems are analyzed in terms of the first and second laws of thermodynamics.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 9 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•15주차 ( 06월 12일, 06월 14일)

- 학습목표: To understand the concept of isentropic efficiencies of a process
- 주요학습내용: Various engineering systems are analyzed in terms of the first and second laws of thermodynamics. Most steady-flow devices operate under adiabatic conditions, and the ideal process for these devices is the isentropic process. The parameter that describes how efficiently a device approximates a corresponding isentropic device is called isentropic or adiabatic efficiency.
- 수업방법: 이론 강의 및 문제 풀이
- 수업자료: Chap. 9 of Borgnakke and Sonntag
- 과제: Assigned Readings and Preparation for Answering Pre-Asked Questions

•16주차 ( 06월 19일, 06월 21일)

(학기말고사 기간이므로 강의 없음, 본 교과목 시험 시간 추후 공고)

- ~~—학습목표:~~
- ~~—주요학습내용:~~
- ~~—수업방법:~~
- ~~—수업자료:~~
- ~~—과제:~~



## Ⅷ. 참고사항(Special Accommodations)

- 사이버캠퍼스 정기적 확인 요망 (가급적 매일)
  - 강의자료, 강의 및 시험 일정 등 주요 공지사항, 과제물 공지 예정
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- 서강톡톡 활용 요망
  - 긴급한 공지사항은 서강톡톡을 통해 공지 예정
- 질문하는 것을 두려워 말 것
  - 강의 중 의문점이 생기면 아무때나 손을 들고 질문할 것(수강생 전원 앞에서의 질의응답은 수강생 모두에게 도움이 되나 개인적인 질의응답은 질문자에게만 도움이 되는 이기적인 행위임).
  - 사이버캠퍼스의 질의응답이나 서강톡톡의 채팅 기능 활용 권장.
  - 그러나 학기 마친 후 letter grade에 대한 이의제기는 금물: weighted sum 계산 중 오류에 대한 시정 요청만 인정(weighted sum과 letter grade의 matching은 강의자의 재량임을 명심)

## Ⅸ. 장애학생 지원 사항(Aid for the Challenged Students)

- 효율적 학습을 위한 지원 (상황에 따라 추가 지원 가능)
  - 좌석우선 배정
  - 과제 제출일 연장
  - 시험기간 연장
- 위의 지원 사항 이외에 장애로 인해 수강 시 추가적인 지원이 필요한 학생들은 개별적으로 찾아와 상의하기 바람.