Course: ENGR 290 – Materials & Thermodynamics, 2018
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Calendar Description

Topics covered in this course include description of point defects, diffusion in solids, dislocations, origin of Gibbs phase rule, phase diagrams, properties of non-ferrous materials, first law of thermodynamics, internal energy, second law of thermodynamics, entropy, availability and irreversible processes.

Intended Learning Outcomes

The primary purpose of this course is to prepare students for entry into a department of Mechanical Engineering at the University level. ENGR 290 reviews material already covered in their background, firming their understanding of the material to ease the transfer into the third year of Mechanical Engineering at the University level.

Upon successful completion of this course a student will be able to:

- Sketch a phase diagram for some common materials and alloys.
- Interpret the phase diagram of any material.
- Discuss the behaviour of polymers.
- Explain the first and second laws of thermodynamics.
- Apply the first law of thermodynamics.
- Apply the second law of thermodynamics.
- Analyze problems in a systematic manner using diagrams in developing and evaluating thermodynamic processes, and applying concepts to steady and non-steady flow processes.
- Apply the concepts of irreversibility and availability.
- Explain and analyze air standard cycles.
- Analyze Rankine, Regeneration and Refrigeration Cycles.
- Analyze ideal and non-ideal gas vapour behaviour.
- Use psychrometric charts as applied to humidification, dehumidification and air conditioning.

Text & References

No textbook is required for this course. However, you should own one of the following recommended texts (any edition is acceptable) to ensure you have what you need for University-level Thermodynamics:

- *Fundamentals of Engineering Thermodynamics* (Moran, Shapiro)
- *Fundamentals of Thermodynamics* (Borgnakke, Sonntag)
- *Fundamentals of Thermal-Fluid Sciences* (Çengel, Cimbala, Turner).

Course Content (subject to modification, if necessary)

Week	Assignments	Course Content
1	-	***Materials*** – Crystallization and diffusion in solids, polymers.
2	-	***Materials*** – Equilibrium phase diagrams.
3	-	***Materials*** – Use of phase diagrams, heat treatment, TTT diagrams.
4	Assign. 1	***Thermodynamics*** – Review of thermodynamic properties, work, heat, development of the 1st Law of thermodynamics.
5	-	***Thermodynamics*** – 1st Law examples, ideal gas law, idealized processes.
6	-	***Thermodynamics*** – Carnot engine and the development of the 2nd Law of thermodynamics.
7	Assign. 2	***Thermodynamics*** – 2nd Law examples, efficiencies of devices operating under irreversible processes.
8	-	***Thermodynamics*** – Review, **MIDTERM exam**.
9	-	***Thermodynamics*** – Vapour power cycles.
10	-	***Thermodynamics*** – Reheat and regeneration vapour power cycles, combined reheat-regen cycle.
11	Assign. 3	***Thermodynamics*** – Vapour refrigeration and heat pump cycles.
12	-	***Thermodynamics*** – Gas power cycles (air-standard analysis, cold air-standard analysis, Otto cycle, Diesel cycle).
13	Assign. 4	***Thermodynamics*** – The Brayton cycle, combined Brayton-Rankine cycle, gas-refrigeration cycles.
14	Assign. 5	***Thermodynamics*** – Psychrometrics, course review.

Lab Assignments & Evaluation

Assignments are due by 5:30 on the Friday of the weeks indicated in the above table.

Assignments	25%	
Midterm Exam	35%	(formula sheet only)
Final Exam	40%	(open notes exam)

→ You must pass the final exam to pass ENGR 290

A+	90 - 100%	**B-**	70 - 72%
A	85 - 89%	**C+**	65 - 69%
A-	80 - 84%	**C**	60 - 64%
B+	77 - 79%	**D**	50 - 59%
B	73 - 76%	**F**	< 50%