1. EM317 Thermal-Fluid Sciences II

2. Credit Hours (3) / Contact Hours (5)

3. Course Director: Assistant Professor Ronald Warzoha

4. Text book: Fundamentals of Thermal-Fluid Sciences, 4th or 5th Edition by Cengel, Cimbala and Turner, McGraw Hill-Education

   Other supplemental materials:
   EM317 Supplemental Text US Naval Academy

5. Specific course information
   a. A basic thermodynamics course in which the first and second laws of thermodynamics are studied primarily from the classical macroscopic viewpoint and applied to both closed and open systems. Working substances include perfect gases, real gases and vapors in addition to solids and liquids. Thermodynamics cycles are covered with specific reference to internal combustion engines, gas turbine engines, steam power plants and refrigeration systems. Methods for improving the performance of thermodynamic cycles are discussed including regeneration.
   b. Prerequisites: EM316 or EM324
      Co-requisites: None
   c. This course is required for the General Engineering Program.

6. Specific goals for the course (course outcomes)
   a. Apply conservation of mass and the 1st law of thermodynamics to the analysis of closed system including the determination of boundary work.
   b. Apply conservation of mass and the 1st law of thermodynamics to the analysis of open systems including nozzles, diffusers, pumps, turbines, compressors, throttling valve, mixing chambers, and heat exchangers.
   c. Determine thermodynamic property information for ideal gases, water, R134a, and R12 utilizing property tables, property diagrams, ideal gas law, and constant specific heats.
   d. Apply the effectiveness NTU method to the analysis of heat exchangers.
   e. Understand the 2nd law of thermodynamics and how it relates to the performance and design of heat engines.
   f. Incorporate isentropic efficiencies in the analysis of systems that utilize turbines, pumps, compressors, and nozzles.
   g. Analyze internal combustion engines using the Otto and Diesel Cycles.
   h. Analyze gas turbine engines using the Brayton cycle, including regeneration, split shaft gas turbines, and aircraft engines.
   i. Analyze steam power cycles using the Rankine cycle, including cycle modifications such as reheat, regeneration, and nuclear power use.
   j. Analyze heat pumps and refrigeration systems using the vapor-compression refrigeration cycle.

7. Specific program outcomes address by this course

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Introduced											
Reinforced	X	X			X		X		X	X	X
Mastered											

8. Brief list of topics to be covered
   a. First Law of Thermodynamics in Closed Systems
   b. First Law of Thermodynamics in Open Systems
   c. ε-NTU Heat Exchanger Analysis
   d. 2nd Law of Thermodynamics
   e. Internal Combustion Engines
   f. Gas Power Cycles
   g. Vapor Power Cycles
   h. Vapor-Compression Refrigeration