ME 405: Thermal Systems Design

Course description: Design and analysis of thermofluid systems using principles of thermodynamics, fluid mechanics and heat transfer.

Number of credits: 3. This course is required.

Course Coordinator: P. Dutta

Prerequisites by course: ME 304; certified major in Mechanical Engineering

Prerequisites by topic:

1. Thermodynamic properties of matter.
2. Work and heat.
3. The first and second laws of thermodynamics.
4. Laminar and turbulent flow of ideal and viscous fluids.
5. Boundary layer flow and pipe flow.
6. Conductive, convective, and radiative heat transfer.

Postrequisites: None

Textbooks/other required materials: S.G. Penoncello, *Thermal Energy Systems: Design and Analysis,* CRC Press, Taylor Francis Group, 1/e, 2015.

Course objectives:

1. The first law of thermodynamics.
2. Calculation of heat loss.
3. Design of piping systems.
4. Pump selection.
5. Calculating conductive, convective, and radiative heat transfer in engineering systems.
6. Analysis of heat exchangers.
7. Second law of thermodynamics.
8. Gas and vapor power cycles.
9. Optimization of multicomponent thermofluid systems.

Topics covered:

1. The first and second laws of thermodynamics.
2. Availability and work potential.
3. Heat loss and heat load calculation.
4. Piping systems and pump selection.
5. Conductive, convective, and radiative heat transfer in engineering systems.
6. Heat exchangers.
7. Gas power, vapor power and refrigeration cycles.
8. Cogeneration and waste heat recovery.
9. Heating, ventilation and air conditioning system.

Expected learning outcomes:

1. Apply the first law of thermodynamics to open and closed systems.
2. Predict the head loss of a pipe or duct system and select an appropriate pump.
3. Determine the heat load of an engineering system.
4. Design a heat exchanger.
5. Apply the second law of thermodynamics to open and closed systems.
6. Optimize the conceptual design of a heat engine and refrigeration system.
7. Design a thermofluid system involving moving fluids, heat transfer, and conversion of energy between heat and work.

Class schedule: Three 50-minute lecture sessions per week, for one semester.

Laboratory schedule: None.

Contribution to meeting the professional component: Engineering Topics

Relationship of course to student outcomes:
3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018 (ABET EC2000)

a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
		3	1	3	1	2	2	2	2	2

Student Outcomes Fall 2018 forward (ABET EC2019)

1	**2**	**3**	**4**	**5**	**6**	**7**
3	3	2	2	1		2

Prepared by: Andrea Butcherite and P. Dutta *Date:* May 30, 2018