King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 458: Design of thermo-fluid systems

Catalogue Description: (3-0-3)

Application of thermodynamics, mechanical engineering design, fluid mechanics, and heat transfer in the design of thermo fluid systems. Introduction to system-oriented design methods. Thermo fluid system component analysis, selection and design. Component and system modeling, simulation, economics and optimization.

Status in Curriculum (Required or Elective): Elective (offered ????)

Prerequisites: ME 204, ME 315

Co-requisites: None

Prerequisites by Topics:

- Power and Refrigeration cycles and HVAC (ME204)
- Fluid Mechanics (ME311)
- Heat Transfer (ME315)

Textbook: **Design of Fluid Thermal Systems**, Janna, W.S., Cengage Learning, 3rd Ed, 2011.

References:

1) **Design and Optimization of Thermal Systems**, Jaluria, Y., 2nd ed., McGraw-Hill, 2007.
2) **Thermo-Fluids Systems Design**, McDonald, A. G., and Magande, H. L., John Wiley, 2012.
3) **Design and Simulation of Thermal Systems**, Suryanarayana, N. V. and Arici, Ö., McGraw-Hill, 2003.

Coordinator: **Dr. Shahzada Zaman Shuja,** Professor of Mechanical Engineering

Goals: (general objectives)

Design of Thermo-Fluid Systems is a capstone course where students integrate previous coursework from different subfields including Fluid Mechanics, Heat Transfer, Thermodynamics, and Engineering Graphics. Furthermore, a group design project is considered a "practicum" which integrates previous student work in a practical setting.

Course Outline (Lecture Topics):

1. Engineering Design Process, Design of Thermal Systems. (3 hours)
2. Design for Environment, Safety and Reliability. (3 hours)
3. Ethical concerns, Manufacturability and Sustainability. (3 hours)
4. Review of Fluid Mechanics, Piping systems, Pumps. (3 hours)
5. Fans, Compressors, Turbines. (3 hours)
6. Review of Heat Transfer, Heat Exchanger Selection and Design. (3 hours)
7. Heat Exchanger Selection and Design. (3 hours)
8. Power Generation, Refrigeration and HVAC Systems. (3 hours)
9. Mathematical Modeling of Thermal Equipment and Systems. (6 hours)
10. System Simulation and Computer Aided Design. (3 hours)
11. Design Optimization and System Performance Evaluation. (3 hours)
12. Exergy and Thermo-economic Analysis, Life Cycle Cost, Cost Estimation. (3 hours)
13. Related Special Topics and Project. (6 hours)

Design Activities/Projects:

A design project is assigned which can be considered a "practicum" and integrates previous student work in a practical setting.

Computer Usage:

In this course, Engineering Equation Solver (EES), MATLAB, SOLIDWORKS Simulation are used to solve design problems.

Laboratory: None

Assessment Tools:

i- Mid-term Examinations

ii- Homework Assignments
iii- Quizzes
iv- Final Exam

Course Learning Outcomes:

I- Apply design processes and procedures to design thermal systems.
II- Understand the basis and criteria of design for environment, safety and reliability, manufacturability and sustainability.
III- Choose a pump/fan, fluid mover to perform adequate fluid flow rate.
IV- Design a series piping/duct system network.
V- Design and analyze a parallel piping/duct system network.
VI- Develop a realistic thermal-fluid design of heating/cooling system including heat exchangers and work on individual components of a composite system.
VII- Simulate and optimize a thermal-fluid system using a computer (EES, Excel, Matlab, SolidWorks).
VIII- Work as a team, dividing up tasks, setting deadlines, reviewing each other's work, working under a leader with a common objective, resolving conflicts.
IX- Use the library and internet to search for technical information.
X- Write technical reports and memos, keep a journal of all project related activities.
XI- Understand codes of ethics and conduct for engineers in the workplace.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	III, IV, V, VI	-	I, II	VIII	III, IV, V, VI	VIII, XI	X	II	VII		VII
Emphasis*	**S**		**S**	**M**	**S**	**M**	**M**	**L**	**L**		**S**

* **L**:: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: March 2, 2015 **Reviewed by:** Dr. Shahzada Zaman Shuja
Prepared by: Dr. Shahzada Zaman Shuja **Date prepared:** February 26, 2015