**ME 379- THERMO-FLUID SYSTEMS**

**3 Credits (3-1-0)**

## Dr. Mohammed Ali and Dr. Basharat Salim

## Office Rooms (2C 73 and 2C 75)

## General Course Information

ME 379 (Thermo-Fluid Systems) is a 3-credit hour (3 weekly lectures and 1 tutorial session) fourth-year course. The main objective of this course is to provide the student with thermal-fluid applications. This course aims at providing the students with design experience in the thermal-fluid area through real life design problems and to relate basic theories to the engineering thermal-fluid applications. This course covers the following topics: Design of piping systems; Performance and selection of pumps, heat exchangers of different kinds such as double pipe, shell and tubes and cross flow; Selection of thermal-fluid system components. During this course, special emphasis is placed on real-life examples in which the above mentioned concepts are relevant. Throughout the semester, students are required to submit homework assignments collect information for their term project, and prepare for the final presentation. The intent of these activities thereby contributes to the achievement of ABET student outcomes SO2, SO4, SO5 and SO7 and NCAAA outcomes S2, C1, C2 and C4.

**Syllabus of the Course**

Design of piping systems and the optimization process; Flow in pipe networks; Pipes in parallel; Performance and selection of pumps; heat exchangers of different kinds such as double pipe, shell and tubes and cross flow; Selection of thermal-fluid system components.

**Table (1) Linking Course Learning Outcomes**

**with ABET Student outcomes and NCAAA Program Leaning outcomes**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CLOs |  ABET SOs | SO1 | SO2 | SO3 | SO4 | SO5 | SO6 | SO7 |
|  NCAAA PLOs | S1 | S2 | S3 | C1 | C2 | C3 | C4 |
| CLO1 | Design of Piping System |  | X |  |  |  |  |  |
| CLO2 | Design and Select Heat Exchanger |  | X |  |  |  |  |  |
| CLO3 | Carryout Economic Analysis of Thermal fluid System |  |  |  | X |  |  |  |
| CLO4 | Work and communicate effectively in a team |  |  |  |  | X |  |  |
| CLO5 | Recognize recent issues in the field of fluid thermal systems. |  |  |  |  |  |  | X |
| CLO6 | Determine the performance characteristics and select suitable pumps. |  | X |  |  |  |  |  |
| CLO7 | Determine the performance characteristics of compressors and fans |  | X |  |  |  |  |  |

**Table (2) Part of Student outcomes that are assessed**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CLO | CLO Description | SO2,S2 | SO4,C1 | SO5,C2 | SO7,C4 |
| 1 | Design of Piping System | SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. |  |  |  |
| 2 | Design and Select Heat Exchanger | SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. |  |  |  |
| 3 | Carryout Economic Analysis of Thermal fluid System |  | SO4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal context  |  |  |
| 4 | Work and communicate effectively in a team |  |  | An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. |  |
| 5 | Recognize recent issues in the field of fluid thermal systems. |  |  |  | SO7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.  |
| 6 | Determine the performance characteristics and select suitable pumps. | SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. |  |  |  |
| 7 | Determine the performance characteristics of compressors and fans | SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. |  |  |  |

**Objective of the Course**

1. The main objective of the course is to provide knowledge of thermofluid to the students.
2. The students will experience real life design problems in thermofluid applications and will use the knowledge gained in the courses of thermodynamics, fluid mechanics and heat transfer for the integrated thermofluid systems.
3. Students could utilize computational models for solution of thermofluid systems.
4. Students will work in team spirit and will show their communication skills both in terms of reports and presentations.

**Credit Hours: 3 (3-1-0)**

**Prerequisites of the Course**

 Fluid Mechanics, Thermodynamics (I and II) and Heat transfer.

**Text Book**

Janna, W.S, “Design of Fluid Thermal Systems” Latest Edition, Cengage Learning, Global Engineering.

**References**

1. Stoecker, B.K, “Design of Thermal Systems” McGraw-Hill, 2nd Edition
2. Hodge, B.K. and Taylor, R.P. “Analysis and Design of Energy Systems” Prentice Hall.
3. McQuiston, F.C, Parker, J.D and Spitler, J.D. “Heating, Ventilating and Air conditioning: Analysis and Design” John Wiley
4. Bejan, A. Tsatsaronis, G and Moran, M “Thermal Design and Optimization” John Wiley and Sons
5. Jaluria, Y. “Design and Optimization of Thermal Systems” McGraw-Hill
6. Burmeister, L.C. “Elements of Thermal Fluid Design” Prentice Hall

**Instruction Methods:**

Three 50 minutes’ lectures and 1 Tutorial

All lectures will be zoom or black board based. One 1 hour lecture in 5th or 6th week will be for showing the equipment in the laboratory.

**Topics of the course**

1. Introduction to Thermal Fluid Systems
2. Piping Systems, I (Standards, friction factor concept and minor losses
3. Piping Systems II (optimization Problems, Piping Symbols and System Curves)
4. Flow through Pipe Network
5. Pumps and Piping Systems (classification and types of pumps, pump testing, cavitation, pump analysis, specific speed, basic piping system design,
6. Performance characteristics of fans and compressors
7. Optimum thickness of insulating pipes
8. Double pipe Heat exchanger (Performance design and analysis, effectiveness and NTU analysis)
9. Shell and Tube Heat Exchanger (Construction, Parts and Nomenclature of Shell and Tube heat exchangers, Design analysis and optimum outlet conditions)
10. Plate, Frame and Cross flow heat exchanger

**Course Assessment**

The assessment of the course will be accumulation of the efforts that the student will put in assignments, term projects, midterms and final examination. Each chapter will be followed by the assignment based on the theory of that chapter. The assignment has to be given on due date. Late assignments will not get any grade. In the assignment the students are supposed give step by step solution rather than just calculation. Each step has to be explained. The term project is based on the subject matter of the course. Students can take term project either from fluid portion or thermal portion. Term paper marks will be based on both the report and presentation.

The breakdown of marks is as under.

|  |  |  |
| --- | --- | --- |
| S.No | Description | Marks |
| 1 | Assignment  | 10% |
| 2 | Term Project Report | 12% |
| 3 | Term Project Presentation | 8% |
| 4 | Midterm1  | 15% |
| 5 | Midterm 2 | 15% |
| 6 | Final Examination | 40% |

**Examination Schedule**

Midterm 1 will be as per college announcement whereas midterm 2 will be rescheduled to some convenient date. Assignment will be collected on exactly due dates only. Final examination will be scheduled by the college.