List of TFS Courses

Thermal/Fluids Systems (TFS) Area
Walker Department of Mechanical Engineering
The University of Texas at Austin

The Thermal Fluid Systems (TFS) graduate curriculum is designed to give all students in the program proficiency in fluid mechanics, heat transfer, and thermodynamics, as well as the mathematical, experimental, and computational tools needed to work in these disciplines. It is also designed to provide students the opportunity to pursue in-depth study in each of these broad disciplines. The required coursework component of the TFS graduate program includes the following:

- **M.S. degree:** Five (5) out of six (6) TFS core-graduate courses.
- **PhD without an M.S. degree:** Five (5) out of six (6) TFS core-graduate courses.
- **PhD with an M.S. degree:** Four (4) out of six (6) TFS core-graduate courses. The students need to meet with the QE committee to get approval on the selection of these 4 courses before starting their first semester. Students who have taken core courses in their previous institution can petition to have them satisfy the required number of TFS core-graduate courses.
- **PhD with an M.S. degree in the TFS area of Mechanical Engineering from the University of Texas at Austin:** no additional graduate coursework.

The TFS core-graduate courses are defined in the following section, followed by a listing of the courses making up the TFS graduate curriculum.

1. TFS Core-Graduate Courses

1. In fluid mechanics, one of the following:
   - ME 381P1: Fundamentals of Incompressible Flow
   - ASE382Q1: Foundation of Fluid Mechanics
2. In heat transfer, one of the following:
   - ME 381R4: Fundamentals of Heat and Mass Transfer, or
   - ME 381R1, ME 381R2 & ME 381R3 (see descriptions in section 2.2 below)
3. In thermodynamics:
   - ME 381Q1: Advanced Thermodynamics
4. In experimental methods, one of the following:
   - ME 382P1: Advanced Experimental Methods for Thermal/Fluid Systems
   - ME 382P2: Lasers and Optics

5. In computational methods:
   - ME 382N3: Computational Methods for Thermal/Fluid Systems
6. In mathematics, one of the following:
   - PGE 381K: Engineering Analysis
   - ASE 380P1: Mathematical Methods in Applied Mechanics I (same as EM386K)
   - ME 380Q1: Engineering Analysis: Analytical Methods

2. Courses in the TFS Curriculum

In the following subsections, courses at The University of Texas at Austin that are recommended for their coverage of topics in the TFS curriculum are listed. Many of these courses are offered by other departments, but they are none-the-less useful for TFS graduate students. Courses that satisfy or partially satisfy requirements as defined in section 1 are indicated by SR or PSR, respectively. Courses are organized into six groups (fluids, heat transfer, thermo, experiments, computations, and math).

2.1 Fluid Mechanics Courses

- Fundamental of fluid mechanics:
  - ME 381P1: Fundamentals of Incompressible Flow SR
  - ASE382Q1: Foundation of Fluid Mechanics SR
- Turbulence:
  - ME 381P3: Dynamics of Turbulent Flow
  - ASE 382Q9: Turbulent Mixing
- Compressible flow:
  - ASE 382Q7: Advanced Problems in Compressible Flow
- Micro/nano scale flow:
  - ME 381P4: Multiscale Flow & Transport Phenomena
- Stratified/Buoyancy driven flows:
  - CE 380S: Environmental Fluid Dynamics
- Modeling and simulation:
  - ME 382N1: Introduction to Computational Fluid Mechanics
  - ASE 382R5: Advanced Computational Methods

2.2 Heat Transfer Courses

- Fundamentals of heat & mass transfer:
  - ME 381R4: Fundamentals of Heat and Mass Transfer

- Conductive and convective heat & mass transfer:
    - ME 381R1: Advanced Conductive Heat Transfer
    - ME 381R2: Advanced Convective Heat and Mass Transfer
    - ChE 387M: Mass Transfer
- Radiative heat transfer:
    - ME 381R3: Radiative Heat Transfer
    - ME 381R5: Radiation in Participating Media
- Heat transfer in multi-phase flows:
    - ME 381R6: Multiphase Flow and Heat Transfer
- Micro-scale heat & mass transfer:
    - ME 381R7: Nanoscale Energy Transport and Conversion
    - ME 381P4: Multiscale Flow & Transport Phenomena
- Heat & mass transfer in reacting flows:
    - ME 382R5: Principles of Combustion Theory

2.3 Thermodynamics & Combustion Courses

- Fundamentals:
    - ME 381Q1: Advanced Thermodynamics
    - ME382Q3: Advanced Thermo/Fluid Systems
- Macro-thermodynamic applications:
    - ME 386P3: Introduction to Thermodynamics of Materials
    - ME 386P6: Kinetic Processes in Materials
- Statistical thermodynamics:
    - ME 381Q4: Molecular Gas Dynamics (same as ASE382R6)
    - ASE 382Q10: Plasmas and Reactive Flows
- Combustion:
    - ME 382R1: Fundamentals of Combustion
    - ME 382R5: Advanced Combustion
    - ME 382R6: Combustion Engine Processes
    - ME 382T: Fire Science
    - ASE 382Q9: Turbulent Mixing
    - ASE 396: Turbulence & Combustion Modeling
- Energy Technology:

- ME 382Q2: Introduction to Renewable Energy
- ME 382Q4: Energy Technology and Policy

2.4 Experimental Methods Courses

- ME 382P1: Advanced Experimental Methods for Thermal/Fluid Systems
- ME 382P2: Optics and Lasers Laboratory

2.5 Computational Methods Courses

- Introduction to computational methods:
    - ME 382N3: Computational Methods for Thermal/Fluid Systems
- Numerical PDE's:
    - CSE 383C: Numerical Analysis: Linear Algebra
    - CSE 383K: Numerical Analysis: Survey of Numerical Methods in Linear Algebra
    - CSE 383L: Numerical Analysis: Differential Equations
    - CSE 393F: Finite Element Methods (same as EM394F & ASE384P4)
    - CE 381R: The Finite Element Method (same as CSE 393.1 The Finite Element Method)
- Computational statistics:
    - SDS 384.9: Computational Statistics
- Computational fluid dynamics:
    - ME 382N1: Introduction to Computational Fluid Mechanics
    - ASE 382R5: Advanced Computational Methods
    - EM 393N: Numerical Methods for Flow and Transport Problems
- Molecular and atomic-scale algorithms:
    - ASE 382Q8: Lagrangian Methods in Computational Fluid Dynamics
- Practical scientific computation:
    - SDS 392: Introduction to Scientific Programming
    - SDS 394: Scientific and Technical Computing
    - SDS 394C: Parallel Computing for Scientists and Engineers

2.6 Mathematical Methods Courses

- Introduction to mathematical methods:
    - PGE 381K: Engineering Analysis SR

    - ASE 380P1: Mathematical Methods in Applied Mechanics I SR (same as EM386K)
    - ME380Q1: Engineering Analysis: Analytical Methods SR
- Analytical methods:
    - ASE 380P2: Analytical Methods II (complex analysis, integral transforms, ODE's PDE's, asymptotics)
    - EM 386L: Mathematical Methods in Applied Mechanics II (Complex analysis, ODE's, PDE's)
    - CSE 386M: Functional Analysis in Theoretical Mechanics (same as EM 386M: Functional Analysis and Linear Operators)
- Probability and statistics:
    - SDS 384.1: Applied Probability
    - SDS 384.7: Bayesian Statistical Analysis
- Advanced applied mathematics:
    - CSE 386C: Methods of Applied Mathematics
    - CSE 386D: Methods of Applied Mathematics