

# Sample Syllabus

## ME 422: Principles of Turbomachinery Syllabus for Spring 2024

NOTE: This information is subject to change with notice on Canvas from Dr. Guimarães.  
*Last updated 1/14/24*

- Instructor:** Dr. Tamy Guimarães, Assistant Professor of Mechanical Engineering  
109 Research East, [guimaraes@psu.edu](mailto:guimaraes@psu.edu)  
Office Hours (via [Zoom](#)): Tuesdays 6-8 pm: Abhi (TA)  
Wednesdays 6-8 pm: Dr. Guimarães
- TA:** Abhinavmitra Vajjala, [avk5168@psu.edu](mailto:avk5168@psu.edu)
- Resident Lecture** M/W/F 2:30 – 3:20 PM @ 18 Research Building East (Zoom and recorded for WEB and World Campus students, available immediately after live lecture)
- Course Materials:** <https://psu.instructure.com>
- Required Text:** *Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition.*  
Authors: S. Larry Dixon, Cesare Hall  
[Access E-Textbook](#)
- Grading:** 10% Participation (in-class for UP students and online for WEB/WC students)  
40% Homework  
25% each two non-cumulative Exams
- HW:** Submit assignments/exams using Canvas at <https://psu.instructure.com>

### Course Description:

This course provides an introduction to the working principles, performance and design of turbomachinery. The course first covers a review of essential fluid and thermodynamics. Concepts relevant to all turbomachines are then introduced. Axial turbines and compressors are studied in depth, including their kinematics, performance and design. The final lectures cover centrifugal machines, propellers, hydraulic turbines and wind turbines.

### Learning Outcomes:

By the end of this course, students will be able to:

- recall and explain the working principles of turbines and pumps/compressors
- calculate basic loading and analyze the performance of a variety of machines
- correlate the fluid-thermodynamic mechanisms to performance degradation in turbomachines
- perform basic design studies
- recall the basic operating principles of centrifugal machines, propellers, hydraulic turbines and wind turbines.

## **Course Instructional Modules:**

### Module 1: Review of Essential Fluid Dynamics and Thermodynamics

- Conservation laws mass, momentum, energy
- Dimensional analysis
- Compressible flow

### Module 2: Introduction to Turbomachinery

- Machine definitions
- Angular momentum
- Euler turbomachinery equation
- Relative frame of reference/rhothalpy
- Velocity triangles
- Performance parameters and losses

### Module 3: Two Dimensional Cascades

- Geometry and flow-field analysis
- Compressor cascades
- Turbine cascades

### Module 4: Axial Turbines

- Kinematics
- Design parameters
- Thermodynamic performance
- Reaction – turbine classification
- Multi-stage performance
- Structural and heat transfer considerations

### Module 5: Axial Compressors

- Kinematics
- Design parameters
- Thermodynamic performance
- Multi-stage performance
- Stall and surge

### Module 6: Centrifugal Machines

- Kinematics
- Centrifugal pumps and compressors
- Diffusers
- Radial turbines

### Module 7: Propellers, Hydraulic Turbines and Wind Turbines

- Propellers
- Cavitation
- Hydraulic turbine classification and design; Wind turbines

## **Grading:**

If you feel there is an error in the grading of an assignment, this must be brought to the attention of the grader **within seven days** of when the scores are posted to Canvas.

The tentative grade assignment for the course is as follows:

- A: 93-100%
- A-: 90-92.9%
- B+: 87-89.9%
- B: 83-86.9%
- B-: 80-82.9%
- C+: 77-79.9%
- C: 70-76.9%
- D: 60-69.9%
- F: 0-59.9%

## **Academic Integrity:**

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Some examples are given below:

- **CHEATING:** Using crib sheet; pre-programming a calculator; using notes or books during a closed book exam, posting, copying solutions, or even checking the validity of your solution with problems on online forums / platforms such as Chegg, etc.
- **COPYING ON TEST:** Looking at another unsuspecting student's exam and copying; copying in a complicit manner with another student; exchanging color-coded exams for the purpose of copying; passing answers via notes; discussing answers in exam, etc.
- **PLAGIARISM:** The fabrication of information and citations; submitting others work from professional journals, books, articles and papers; submission of other students' papers or lab results or project reports and representing the work as one's own; fabricating in part or total, submissions and citing them falsely, etc.
- **ACTS OF AIDING OR ABEADING:** Facilitating acts by others; unauthorized collaboration of work; permitting another to copy from exam; writing a paper for

- another; inappropriately collaborating on home assignment or exam without permission or when prohibited, etc.
- **UNAUTHORIZED POSSESSION:** Of examinations, through purchase or supply; stealing exams; failing to return exams on file; selling exams; photocopying exams; buying exams; any possession of an exam without the custodian's permission, etc.
  - **SUBMITTING PREVIOUS WORK:** Submitting a paper, case study, lab report or any assignment that had been submitted for credit in a prior class without the knowledge and permission of the instructor.
  - **TAMPERING WITH WORK:** Changing own or another student's work product such as lab results, papers, or test answers; tampering with work either as a prank or in order to sabotage another work, etc.
  - **GHOSTING:** Taking a quiz, an exam, performing a laboratory exercise or similar evaluation in place of another; having another take a quiz, an exam, or perform an exercise or similar evaluation in place of the student, etc.
  - **COMPUTER PROGRAM THEFT:** Electronic theft of computer programs, data, or text belonging to another etc.

Specifically, for this course:

- First offense: Zero score for the assignment in question, and infraction reported to the College.
- Second offense: Failure of the course and infraction reported to the College.

### **Academic Accommodation:**

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. Student Disability Resources (SDR) website provides (<http://equity.psu.edu/sdr/disability-coordinator>). For further information, please visit [Student Disability Resources website](http://equity.psu.edu/sdr/) (<http://equity.psu.edu/sdr/>).

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: [See documentation guidelines](http://equity.psu.edu/sdr/guidelines) (<http://equity.psu.edu/sdr/guidelines>). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

### **Educational Equity:**

Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the Report Bias webpage (<http://equity.psu.edu/reportbias/>).

## **Counseling and Psychological Services:**

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

### **[Counseling and Psychological Services at University Park \(CAPS\)](http://studentaffairs.psu.edu/counseling/)**

<http://studentaffairs.psu.edu/counseling/>

814-863-0395

### **Penn State Crisis Line (24 hours/7 days/week)**

877-229-6400

### **Crisis Text Line (24 hours/7 days/week)**

Text LIONS to 741741