**San José State University**

# College of Engineering / Aerospace EngineeringAE 269

#  Advanced Computational Fluid Dynamics, Section 01, Fall 2022

## Course and Contact Information

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| Instructor(s): | Brian Andrade |
| Office Location: | Engineering 107 |
| Email: | Brian.andrade@sjsu.edu |
| Office Hours: | MW 5:20-6:00 PM & by appointment (Possibly subject to additional office hours creation) |
| Class Days/Time: | Friday, 3:00 PM-5:45 PM |
| Classroom: | Engineering 329 |
| Prerequisites: | BS Aerospace Engineering, BS Mechanical Engineering or instructor consent. |

## Course Description

Introduction to advanced topics in computational fluid dynamics utilizing STAR-CCM+. Some potential concepts include multi-species flow modeling, conjugate heat transfer modeling, rotating machinery/turbomachinery modeling, and multi-phase flow modeling.

## Course Format

**In-Person**

All materials (reference, materials, announcements, grades, etc), including those necessary for in-person components, shall be conveyed via Canvas. Some materials may be provided by means of a free service outside of Canvas, in such case a link to the material shall be made available on Canvas along with notice of what the material is. This course will require internet connectivity to access these course materials on Canvas and elsewhere.

This course will require access to a computer to run the simulation software.

## Program Information

This class is administered in support the Masters of Science in Aerospace Engineering degree programs for the Aerospace Engineering Department. For any questions regarding the programs or department please refer to the Aerospace Engineering Department webpage ([www.sjsu.edu/ae](http://www.sjsu.edu/ae)) or office (Engineering building, room 272)

## Course Goals

Familiarize students with the basics of CFD and some advanced methods used for modeling more complex scenarios.

## Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. Explain the applications and use cases of computational fluid dynamics
2. Demonstrate ability to identify and repair issues with the geometric setup of a problem preparatory to CFD
3. Describe the differences between spatial models (Axisymmetric, 2D, 3D) and their applications
4. Describe the different types of meshes generally available and explain their advantages and disadvantages
5. Explain the various types of boundary conditions and their use cases. Demonstrate ability to choose correct boundary conditions.
6. Demonstrate the ability to develop a suitable mesh for a variety of scenarios.
7. Demonstrate the ability to select physics models applicable to a variety of problems.
8. Demonstrate ability to identify and extract measurable quantities of interest from a simulation.
9. Demonstrate the ability to appropriately visualize flow fields in a simulation.
10. Demonstrate ability to validate a CFD simulation via various means including first order hand calculations, theoretical first principles, empirical comparisons and mesh independence studies.
11. Clearly convey the details, setup, and results of a CFD simulation using professional and appropriate grammar, nomenclature, formatting, and figures.

## Required Texts/Readings

Readings for this course will principally consist of material from lecture slides and the expansive help documentation on STAR-CCM+. The lecture slides shall be made available as lectures progress and the help documentation shall be made available during the first days of class.

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## Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

The assignments for this course will consist of multiple reports which students will be required to construct regarding all aspects of constructing various simulation case studies. These reports are the medium by which students may demonstrate satisfaction of the course learning objectives.

Reports and the simulations their case studies are based on shall be individually completed and submitted however collaboration between students in understanding and completing these simulations is encouraged.

## Grading Information

There shall be multiple reports due over the course the semester based upon simulations conducted. These reports shall be graded on a different basis than traditional report grading. The assessment of each report shall be conducted based on the demonstration of satisfaction of course learning objectives and additional advanced topics. To pass the class with a satisfactory, but not exemplary, grade requires, at minimum, complete satisfaction of these course learning objectives demonstrated over multiple reports. Higher grades will be earned by demonstration of competency with these advanced topics. To some extent these advanced topics will be determined by class interest during the semester.

It is expected that there will be 3-4 advanced topics over the course of the semester. For a grade of A, all advanced topic competencies must be proven. For a minimally passing grade of C, only the course learning objectives must be repeatedly demonstrated.

All reports will receive of three grades, high-pass, low-pass, and needs revision.

High pass indicates demonstration of competency in the advanced topic for that report/simulation as well as in the areas described by the course learning objectives.

Low pass does not indicate demonstration of competency in the advanced topic for that report/simulation but does in the areas described by the course learning objectives.

Needs revision demonstrates competency in neither and will need to be revised and re-submitted.

Lab Grade

NOT ALL REPORTS MAY BE ELIGIBLE FOR A HIGH PASS SCORE

It is expected that the first report or two will be more basic topics, not able to demonstrate anything beyond the course learning objectives. The highest possible score for these is low-pass.

The overall score for the class shall be determined by the linerarly interpolating between the two extremes described below.

100%: High pass in all eligible lab reports

70%: Low pass in all lab reports

**MUST RECEIVE AT LEAST A LOW-PASS IN ALL LAB REPORTS TO RECEIVE PASSING GRADE OVERALL IN CLASS**

You are permitted to revise lab reports. Two revisions allowed per report. Revisions must be submitted within two weeks of report feedback being posted. This timeline for revisions may be truncated in proximity to the end of the semester, such adjustment to the due date for revisions shall be announced in class as needed.

## Classroom Protocol

## Class shall be in person. This class involves heavy use of simulation software. It is expected that students have access to a Windows or Linux laptop or secure the use of one through available campus services. Alternatively remote access to an appropriate Windows or Linux machine (laptop or desktop) may also be sufficient. It is likely that simulations will need to be run overnight in some or all cases. Appropriate time will be allocated for simulations however students should be exceptionally aware that it is NOT possible to complete many simulations last minute and simulations will frequently need to be modified and fixed due to errors.

Some of these aspects regarding the classroom and required computing hardware are potentially in flux. Every attempt is being made to resolve them before the start of the semester and future information shall be made available as soon as possible.

For in person components, masks are required per SJSU policy regardless of vaccination status against COVID-19. Participation will not be permitted without a mask.

## University Policies

Per [University Policy S16-9](http://www.sjsu.edu/senate/docs/S16-9.pdf) *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.