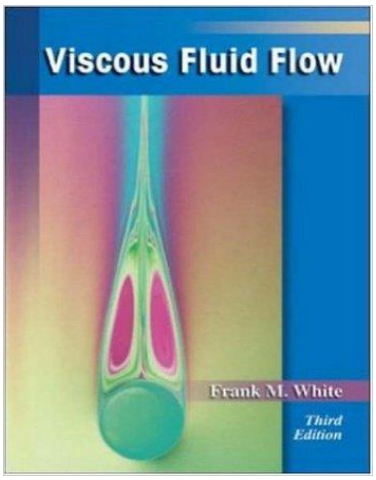
ME420, ME520, and CE520 – Fluid Dynamics
Fall 2015

Course Instructor and Contact Information

Instructor:	Tao Xing, Ph.D., P.E.
Office:	EP 324F
Course Schedule:	9:30 − 10:20am MWF at TLC 122
Office Hours:	8:30 – 9:20am MWF
Email contact:	xing@uidaho.edu
Research Website:	http://www.taoxing.net

Course Textbook

The course textbook is:



White, F. M., Viscous Fluid Flow, 3rd edition, McGraw Hill, New York, 2006, ISBN: 0-07-240231-8

In addition to the course textbook, additional handouts and lecture notes will be made available on the course BbLearn website.

Course Description from UI Catalog

Same as CE J420/J520. Cr not granted for both ME 420 and ME 520. A second fluid dynamics course featuring vector calculus and integral and differential forms of the conservation laws. Topics include fluid properties, fluid statistics, inviscid flow; conservation of mass, momentum, and energy; and turbulence. Other topics may be covered. Additional projects/assignments reqd for grad cr.
Prereq: Engr 335, Math 310, or Permission

Course Learning Objectives

Students will:

- be familiar with the properties and behavior of fluids, classification of various types of flows, and understand the basic concepts of boundary layer and its importance in fluid mechanics.
- be familiar with the hydrostatic equation and Bernoulli equation and their applications to engineering problems.
- be familiar with the Reynolds Transport Theorem and differential form and integral form of the four basic principles of fluid mechanics: continuity equation, momentum

equation, energy equation and state equations, and their application to engineering problems.
- be able to perform dimensional analysis and use non-dimensional parameters to solve fluid flow problems, and do similitude and modeling in fluid mechanics.
- be familiar with the internal and external flows.
- have the basic knowledge of turbulent flows
- learn how to calculate lift and drag forces.
- explore the potential flow theory and its applications

Course Web Site

All course-related material is available on the course BbLearn website. If you are a registered student in the class, you will automatically receive an invitation to the class website. Check it frequently. Download any items of interest that you find there!

Assignments and Homework Submission

Reading and homework assignments will be posted on the course website. Graduate students will be assigned additional homework problems that are more difficult than those assigned to undergraduate students. Homework assignments are due at the beginning of the class period posted on the course website. Homework not submitted at the beginning of the class period is considered late and will receive a grade of zero. For ease of grading, and for consistency, each homework assignment must be submitted as follows,

- Print out the homework assignment sheet(s) from the course website on BbLearn and staple it on top of the completed homework assignment.
- Make sure your name and signature are filled in on the cover page.
- Use only 8 ½ × 11 inch paper. Engineering paper is preferred.
- Do not rip paper out of a spiral notebook unless you cut off all the messy fringes and frays.
- Staple all pages, including the cover page(s), together in the upper left hand corner (no folding please).
- One problem per page is preferred, but short problems can be combined on one page. If so, draw a dark line between the problems to clearly separate them.

Exams and Final Course Project

All three exams will be closed book. However, you are allowed to bring a formula sheet to write down key governing equations that you think are important. Different exams will be given to undergraduate and graduate students. The American Society of Mechanical Engineers (ASME) has developed program-specific criteria for mechanical engineering programs seeking accreditation. According to the ASME students must be able to work professionally in bot thermal and mechanical systems areas. The UI Department of Mechanical Engineering interprets ‘work professionally’ as meaning having the ability to conduct and communicate effective engineering design. To accomplish this objective, the Final Course Project in this course is open-ended problems. The problems can be either selected by the students related to their research or provided by the instructor if students cannot find an appropriate problem. The instructor will meet each

student to discuss the objective, approach, and tasks and schedule for them to finish the project in time. A final presentation and/or report for the course project will be used as the final exam.

Software

Some of the homework problems may require the use of Engineering Equation Solver (EES), MatLab, and/or Mathcad. The EES software on the course website is for UI Mechanical Engineering Student use only. Please do not distribute the software or the EES.DFT file to anyone other than a UI Mechanical Engineering student. If you have a previous version of EES, it is suggested that you install the newest version from the course website over the old installation. For the final course project, you may use EES or any other software you are familiar with, including but not limited to, CFD (e.g. ANSYS FLUENT), Mathcad, and MatLab, etc. A temporary license file of using Tecplot 2013 may be provided to students for free during the final course project. Tecplot can be used for making vector plots, streamline plots, and contour plots.

Course Grading

Your total course percentage will be made up of the following,

Homework (Individual)	20%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Course Project (Team)	25%
Instructor's Assessment	10%

Course grades will be assigned on the following scale: 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, <60% = F. The instructor reserves the right to adjust the scale according to overall class performance.

Academic Honesty

As a student enrolled at the University of Idaho, you are bound by the UI Student Code of Conduct. Article II, Section 1 of this code addresses academic honesty. This code states …

> *Cheating on classroom or outside assignments, examinations, or tests is a violation of this code. Plagiarism, falsification of academic records, and the acquisition or use of test materials without faculty authorization are considered forms of academic dishonesty and, as such, are violations of this code. Because academic honesty and integrity are core values at a university, the faculty finds that even one incident of academic dishonesty seriously and critically endangers the essential operation of the university and may merit expulsion.*

Violation of this code will not be tolerated in this course and will be reported immediately to the Office of the Dean of Students for review.

Professionalism

You are training yourself, through formal education, for a career in engineering or a related field. Professional integrity is expected in the workplace, and it is also expected in the classroom. This includes, but is not limited to,

- On-time class attendance. In your professional career, you will no-doubt be involved in many things requiring your on-time attendance (meetings, conferences, etc.). Entering a meeting, presentation, or a class lecture late is a distraction for everyone. It can completely derail the proceedings. Distractions like this can cause those who are trying to focus to lose their concentration.
- Attention during class. It is my sincere hope that you never will have to deal with people talking, whispering, laughing, eating, internet-surfing, or doing other distracting things while you are giving a presentation. For the presenter, this is not a pleasant experience at all. It causes one to lose his/her train of thought very quickly. Activity that distracts the presenter also distracts those in the room who *want* to hear the material in more ways than one. Causing a presenter to stumble because of distractions degrades the quality of the presentation. Distracting activity directly affects those around you who are interested in the subject material and *want* to hear the presentation.

  Respecting the individual presenting the information and respecting your peers that surround you in the room by refraining from distracting activity is truly professional in every sense of the word.
- Cell phones. This falls under the previous category, but it warrants a separate bullet. Hearing a cell phone ring during a presentation is a huge distraction for everyone. Sending and receiving text messages or surfing the internet is distracting you from the material being presented. I respectfully request that you **turn your cell phone off** during the class period.
- Courtesy and respect. These represent the pinnacle of professional integrity. Exhibiting courtesy and respect to others is absolutely essential for effective communication.

Tentative Class Schedule is in the next page
(may be updated through the semester!!)

Course Syllabus

Lec	Date	Day	Topic	Reading
1	24-Aug	M	Introduction (Definition of fluid and continuum hypothesis)	1-1, 1-2
2	26-Aug	W	Scales and fluid properties	1-3.1, 1-3.2, 1-3.3
3	28-Aug	F	Transport Properties, Surface Tension, Cavitation	1-3.4, 1-4.5, 1-4.6
4	31-Aug	M	Flow Patterns; Hydrostatic Pressure	2-3
5	2-Sep	W	Hydrostatic Pressure on Plane and Curved Surfaces	2-4
6	4-Sep	F	Euler Equation	2-4.6
	7-Sep	M	**LABOR DAY HOLIDAY - UI CLOSED**	
7	9-Sep	W	Buoyancy and stability; rigid body translation and rotation	Lecture notes
8	11-Sep	F	Reynolds Transport Theorem and Mass Conservation	2-13
9	14-Sep	M	Linear momentum equation	2-13
10	16-Sep	W	Relative inertial coordinates and energy equation	2-5
11	18-Sep	F	Comprehensive problems	Lecture notes
12	21-Sep	M	Differential RTT, continuity, and momentum	Lecture notes
13	23-Sep	W	Review of Exam 1	Lecture notes
14	25-Sep	F	Exam 1	
15	28-Sep	M	Energy Eqn., boundary conditions and vorticity theorems	Lecture notes
16	30-Sep	W	Exact Solutions of Navier-Stokes equations	2-4.4, 2-9, 3-3.1
17	2-Oct	F	Exact Solutions of Navier-Stokes equations (cont'd)	Lecture notes
18	5-Oct	M	Dimensional analysis I	2-9
19	7-Oct	W	Dimensional analysis II	2-9
20	9-Oct	F	Viscous laminar pipe flow	Lecture notes
21	12-Oct	M	Stability and transition	Chapter 5
22	14-Oct	W	Turbulence I	6-1, 6-2, 6-3
23	16-Oct	F	Turbulence II	6-4, 6-5, 6-7, 6-9
24	19-Oct	M	Introduction to ME subsonic wind tunnel and final project	Lecture notes
25	21-Oct	W	Hands-on wind tunnel Lab	Lab handout
26	23-Oct	F	Exam 2	
27	26-Oct	M	Turbulent pipe flow	6-5
28	28-Oct	W	Four types of pipe flows and multiple pipe system	Lecture notes
29	30-Oct	F	Flow past Immersed Bodies	Lecture notes
30	2-Nov	M	Laminar boundary layer	Chapter 4
31	4-Nov	W	Introduction to CFD	Lecture notes
32	6-Nov	F	Introduction to CFD (Cont'd)	Lecture notes
33	9-Nov	M	Transition and Turbulent Boundary Layer	6-6
34	11-Nov	W	Boundary layer with pressure gradient and separation	6-8
35	13-Nov	F	Potential Flow Theory I	Lecture notes
36	16-Nov	M	Potential Flow Theory II	Lecture notes
37	18-Nov	W	Potential Flow theory III	Lecture notes
38	20-Nov	F	Potential Flow theory IV	Lecture notes
	23-Nov	M	**FALL BREAK**	
	25-Nov	W	**FALL BREAK**	
	27-Nov	F	**FALL BREAK**	
39	30-Nov	M	In class discussion of final project	
40	2-Dec	W	Advanced topics I: Visualization of fluid dynamics	Lecture notes
41	4-Dec	F	Exam 3	
42	7-Dec	M	Advanced topics II: Demonstration of Tecplot 360	Lecture notes
43	9-Dec	W	Advanced topics III: vortical structures for blunt body	Lecture notes
44	11-Dec	F	Advanced topics IV: desalination	Lecture notes
45	15-Dec	T	**Final Project Presentation 10am-12:00noon (TLC 122)**	