ME408 – Aircraft Performance and Design

Fall 2021 Course Syllabus

1) Instructor Information

Jim Geiger (Adjunct Professor)
(857) 363-1453 (Cell)
jgeiger@bu.edu

I am available to meet with students via Zoom as the need arises. I don't have any specific office hours, but I am generally available during week days, 9 to 11 AM, and 2 to 4 PM, however it is best to confirm the date and time prior to meeting. I do make every effort to respond promptly to e-mail. You can e-mail me at any time with questions, but … ***PLEASE INCLUDE ALL TEAM MEMBERS ON E-MAIL DISTRIBUTION!!***

2) Course Objectives

a) Expose students to the **key elements** of conceptual, fixed-wing aircraft design: Requirements, Sizing, Performance, Wing-Fuselage-Empennage Design, Enhanced Lift, Structural Design, Stability & Control and Cost Estimation.

b) Demonstrate the fundamental, **iterative nature** of design through complete aircraft design projects that run parallel to the course material.

c) Students learn to design **multiple types** of fixed wing aircraft and gain appreciation for what drives the three basic types: Commercial Transport, General Aviation and Military.

d) Establish a foundation for the **fundamental principles** of aircraft design, especially for Aero-Concentrators who, on successful completion of ME408, may select an aircraft design related project for ME461.

3) References

a) Required Texts:

Primary Text Book; "Design of Aircraft", Corke, Thomas C., Prentice Hall, 2003

Reference Text Book; "Theory of Wing Sections", Abbott, Ira Herbert and von Doenhoff, Albert Edward, Dover Publications, 1949

Other Resources: Jane's All the Worlds Aircraft in four (4) separate volumes published yearly. Note: The BU Library has begun to purchase new volumes. Here is the latest;

Jane's All the Worlds Aircraft-Dev & Prod 2013/2014
Jane's All the Worlds Aircraft-In Service 2015/2016
Jane's All the Worlds Aircraft-Unmanned 2014/2015
Jane's All the Worlds Aircraft -Aero Engines 2015/2106

Also, the MIT Library has a good selection of Jane's volumes.

b) Other Texts

"Aircraft Design", Sadraey, Mohammad H., Wiley, 2013

"Aircraft Engine Design", Mattingly, Jack D., Heiser, William H., Daley, Daniel H., AIAA Education Series, 1987 … (Chapters 2 and 3 only).

4) Class Attendance

Class attendance is highly recommended; however, I will not be taking attendance so technically it is optional. This is a team-oriented course, so missing class will affect your team as well as yourself.

The expectation is that each class will be video recorded, so that if anyone does miss class, they can watch the video at some later time.

Often time's students will be asked to bring their laptops to class for hands-on exercises. Students are also encouraged to bring their texts to class.

5) Grades

The individual course letter grades for this course will be based on the BU point system.

Points	Letter Grade	Honor Points
95+	A	4.0
90-94.99	A-	3.7
85-89.99	B+	3.3
80-84.99	B	3.0
75-79.99	B-	2.7
70-74.99	C+	2.3
65-69.99	C	2.0
60-64.99	C-	1.7
55-59.99	D	1.0
<55	F	0.0

Points will be awarded to each team based on a series of Design Reviews. Each review will involve a team presentation to the class and Instructor according to the following schedule (content and dates perhaps subject to change, if need be).

Course Item	Content	Max Points	Presentation Date
Conceptual Design Review (CDR)	Mission Analysis Design Point Selection Competitive Assessment	25 + 2*	9/21/2021
Preliminary Design Review #1 (PDR1)	Main Wing Design Fuselage Design Landing Gear Design Empennage Design Competitive Assessment	25 + 2*	10/14/2021
Preliminary Design Review #2 (PDR2)	Propulsion System Design Takeoff & Landing Analysis Enhanced Lift (Flaps) Design Competitive Assessment	25 + 2*	11/9/2021
Final Preliminary Design Review (PDR3)	Structural Analysis Static Stability & Control Cost Estimate Competitive Assessment Final Preliminary Design	25 + 2*	12/9/2021

* A bonus 2 points is awarded to the team with the best design, as judged by the instructor.

There is no final exam for this course.

6) Team Projects

a) Projects

There are nine (9) team projects offered the students to work through out the semester. Each project is a complete, aircraft design project that runs parallel to the course lecture material. Student teams will work the project together and make four (4) presentations to the entire class during the semester.

The nine (9) projects offered for Fall 2021 are;

Military
-Long Range Strike Bomber
-Multirole Fighter

Commercial
-Twin Jet Airliner

General Aviation
-Business Jet
-Agricultural Sprayer / Aerial Firefighter
-Single Engine Piston
-Aerobatic Sport-plane

Other
-Single Seat Ultralight
-US Light Sport Aircraft (LSA)

Each team will be expected to work the entire design project throughout the Semester.

b) Teams

Members
Each student will be placed on a team based on project selections made by the students. The first class of ME 408 is primarily a review of the nine (9) projects offered to give students some context about each project. The first assignment is to review the design projects and submit to the Instructor (jgeiger@bu.edu) your top three or four choices. All efforts will be made to form teams with each student's top choices.

Trades
Each team will have the option of one (1) "trade" during the semester. The trade option is voluntary, not required and intended to give teams the option of improving upon team chemistry, in the event that personalities are getting in the way of team progress and morale. The trade must be one-for-one and both teams involved in the trade must be in full concurrence that the trade is approved. If a trade cannot be worked out to the satisfaction of all concerned, then the team seeking a trade must find a way to "soldier on" with the current team members as is. Once the details of the trade have been determined, all parties should consult with the Instructor to finalize the trade.

Team Presentations

Each Team will present the status of their designs to the class on four (4) occasions during the semester (see section 5 above for details). Each presentation will be graded. Details of the expected content and examples for each presentation will be given during the semester prior to each presentation.

Team Participation

Each member of the team will receive the same grade for a given presentation. NOTE: This fact that all team members receive the same grade is the reason why each team member needs to contribute to the team in a fair manner. Teams that struggle in ME 408 almost ALWAYS have a team participation issue as a root cause to their problems.

Mid-Term Peer Evaluations

Each team member will have a chance to anonymously rate his or her team mates on overall contribution to the team. If the evaluations show clear evidence that a team member is not contributing to the team in a fair and equitable way, based on the other team members input, then a meeting with the Instructor will be arranged and a plan outlined to improve performance. If the behavior persists throughout the semester, then the final grade of the underperforming student(s) will be modified, downward, to reflect the injurious behavior of the student overall team chemistry.

7) ME408 Class Calendar, Fall 2021

Scroll to next page. Note that all dates are tentative. We will stick to this schedule as close as possible, but may need to and will adjust the dates and/or course material if situations arise that call for it.

ME408 - Aircraft Performance and Design

Fall 2021 Class Schedule

Date	Day	Corke Chapter	Lecture Topic
9/2/2021	Thu	1	Course Introduction, Syllabus, Team Project Descriptions
9/7/2021	Tue	2 &3	Mission Analysis - Mission Profile, Aircraft Aerodynamics, Propulsion, Weights
9/9/2021	Thu	2 &3	Mission Analysis - Mission Profile, Aircraft Aerodynamics, Propulsion, Weights
9/14/2021	Tue	2 &3	Design Point Selection - Matching Chart
9/16/2021	Thu	2 &3	Design Point Selection - Matching Chart
9/21/2021	**Tue**		**Team Presentations - Conceptual Design Review (CDR)**
9/23/2021	Thu	4	Main Wing Design - Airfoil selection, 3D wing parameters, Max Lift Coefficient, Drag Calculations
9/28/2021	Tue	5	Fuselage Design - Volume Calculations, Drag Calculations, Landing Gear Design, Armament Design
9/30/2021	Thu	5	Fuselage Design - Volume Calculations, Drag Calculations, Landing Gear Design, Armament Design
10/5/2021	Tue	6	Empennage Design - Sizing, Shape and Placement (stall control and spin control)
10/7/2021	Thu	6	Empennage Design - Sizing, Shape and Placement (stall control and spin control)
10/12/2021	Tue		NO CLASS (Holiday, Substitute Monday Schedule)
10/14/2021	**Thu**		**Team Presentations - Preliminary Design Review #1 (PDR1)**
10/19/2021	Tue	7	Propulsion System Design - Engine Scaling, Propeller Design, Hybrid Electric and All Electric Propulsion
10/21/2021	Thu	7	Propulsion System Design - Engine Scaling, Propeller Design, Hybrid Electric and All Electric Propulsion
10/26/2021	Tue	7	Propulsion System Design - Engine Scaling, Propeller Design, Hybrid Electric and All Electric Propulsion
10/28/2021	Thu	8 & 9	Enhanced Lift - Takeoff and Landing Performance, Flap Design
11/2/2021	Tue	8 & 9	Enhanced Lift - Takeoff and Landing Performance, Flap Design
11/4/2021	Thu	8 & 9	Enhanced Lift - Takeoff and Landing Performance, Flap Design
11/9/2021	**Tue**		**Team Presentations - Preliminary Design Review #2 (PDR2)**
11/11/2021	Thu	10	Structural Design and Material Selection - Design Load Factor, Shear and Bending Moment Diagrams, Materials
11/16/2021	Tue	11	Static Stability and Control - Refined Weight Estimate, Static Margin, Stability Coefficients
11/18/2021	Thu	11	Static Stability and Control - Refined Weight Estimate, Static Margin, Stability Coefficients
11/23/2021	Tue	11	Static Stability and Control - Refined Weight Estimate, Static Margin, Stability Coefficients
11/25/2021	Thu		NO CLASS (Holiday)
11/30/2021	Tue	12	Cost Estimate
12/2/2021	Thu	13	Design Summary and Trade Study
12/7/2021	Tue		Prep for Final Project Presentations
12/9/2021	**Thu**		**Team Presentations - Preliminary Design Review #4 (PDR4)**
12/14/2021	Tue		NO CLASS (No Final Exam)
12/16/2021	Thu		NO CLASS (No Final Exam)