

MAE 215 – Introduction to Aerospace Engineering
Mechanical and Aerospace Engineering Department – West Virginia University
Fall 2021, MWF 12:00 – 12:50 PM, G-39 ESB

Instructor: Dr. Christopher Griffin, Teaching Assistant Professor, MAE Dept.
 Office Hours: M/W 2 – 3 PM, Thursdays 1 – 2 PM, or by appointment (open door policy)
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Course Description

MAE 215 covers the fundamental physical quantities of flowing gas. Topics include thermodynamics of ideal gas flow using the equation of state and three conservation equations, relating total pressure to total temperature using the concept of entropy and the associated isentropic equations, the standard atmosphere, basic aerodynamic equations, airfoil nomenclature, lift, drag, and aircraft performance. Students will be expected to use MS Word, MS Excel, MS Project, MATLAB, and SolidWorks in this course.

Course Prerequisites: MATH 155 and ENGR 102

Course Textbook: Eyes Turned Skyward by Patrick H. Browning and John L. Loth, Morgantown, WV, 2015. ISBN-13: 978-1-943665-02-0

General Course Outline

- Ch. 1 (2hrs) Introduction to Aerospace Engineering (brief history)
- Ch. 2 (3hrs) Units and the State Equation (relating density to pressure and temperature)
- Ch. 3 (5hrs) Orbital Mechanics and the Standard Atmosphere (investigate orbital calculations calculate pressure and temperature values at all altitudes)
- Ch. 4 (17hrs) Conservation Equations (continuity, momentum, and energy equations to solve for velocity, pressure, temperature, and density); Viscous Effects (use empirical coefficient to find drag on bodies in flow)
- Ch. 5 (12hrs) Aerodynamic Shapes (2D incompressible flow airfoil lift and drag, 3D wing lift and induced drag)
- Ch. 6 (3hrs) Aircraft Performance (power required, range, endurance, climb rate, take-off, landing, and turns)

Assignments & Grading (“FCG” – Final Course Grade)

Assignment	Date	No. of Assignments	FCG (%)	ABET Outcome
Homework and Quizzes	TBA	~15	10%	2
Mid-Term and CC* Exams				
Exam 1 (Ch. 1-3); CC Topics 3,4,5,6,14,15	09/20	1	18%	
Exam 2 (Ch. 4); CC Topics 7,8,9,10,17	10/25	1	18%	
Exam 3 (Ch. 5); CC Topics 1,2,11,12,13,16	11/17	1	18%	
STEM Surveys	TBA	3	2%	
Semester Project				
Project Milestones	TBA	4	2%	5
Project Report & Fly-off	TBA	1	10%	2 & 5
Professional and Global Issues Exercises	TBA	~2	2%	2
Engineering Teams Exercises	TBA	~2	2%	5
Final Exam (Cumulative)	12/15	1	18%	

Final course grade will be submitted as: A (≥89.5%), B (≥79.5%), C (≥69.5%), D (≥59.5%), F (<59.5%)

*Critical Competencies

Critical Competencies have been developed to assess whether MAE 215 students have obtained the minimum standards of understanding of the MAE 215 course material. The Critical Competency Topics are attached to this syllabus, and will be evaluated on each Mid-Term Exam. Each student must score a 70% or better to pass the Critical Competency portion of each Mid-Term Exam. Failure to achieve a score of 70% or better will result in a reduction of that Mid-Term Exam grade by 30%. The Critical Competency questions are designed to be easily answered correctly by students whom attend class regularly, read and understand the book, and have basic skills in math and physics.

Key Course Objectives

It is the intent of this course that:

1. Students will be exposed to and discuss the fundamental components of aerospace engineering.
2. Students will be able to utilize knowledge from (1.) and apply effective problem solving skills to evaluate and/or design basic aerodynamic-related configurations.
3. Students will have discussion related to contemporary ethical and professional responsibilities and practices as related to the field of engineering.

Key Course Learning Outcomes

Through satisfactory completion of homework, quiz and exam problems, as well as through classroom discussion, successful students will be able to:

- | | ABET Outcome* |
|--|---------------|
| 1. Analyze basic molecular behavior related to large scale (atmospheric layer) and small scale (local fluid) flows; | |
| 2. Apply basic fluid flow conservation principles to engineering problems that meet specific needs; | 2 |
| 3. Calculate aerodynamic forces exerted on specific bodies within steady gas flows using empirical formulae and coefficient plots; | 2 |

Additionally, through the satisfactory completion of the course final project, successful students will be able to:

- | | |
|---|---|
| 1. Effectively work in teams outside the classroom to design a glider which meets the given design constraints; | 5 |
| 2. Work in teams to assemble a professional report which describes the glider design and provides evidence of deliberate design based upon analytical and numerical flight performance estimations; | 5 |
| 3. Verbally convey key glider concepts and design ideas to peers and judges during the glider fly-off competition. | 5 |

Additionally, through the satisfactory completion of the professional obligations and ethical responsibilities, successful students will be able to:

- | | |
|--|---|
| 1. Develop and disseminate personal views relating to contemporary engineering ethical and professional responsibilities applied to specific cases (historical or hypothetical). | |
| 2. Incorporate public, social, and economic factors into engineering solutions. | 2 |

*Prescribed ABET Course Outcomes for MAE 215

ABET Outcome 2: Upon graduation, all Bachelor of Science Students in mechanical or aerospace engineering will have an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

ABET Outcome 5: Upon graduation, all Bachelor of Science Students in mechanical or aerospace engineering will have an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Fall 2021 General Academic Calendar Key Dates

AUG 18	First Day of Classes	NOV 16	Last Day to Drop/Withdraw
AUG 24	Last Day to Modify Courses	NOV 20-28	Fall Recess (No Classes)
SEP 06	Labor Day (No Classes)	DEC 09	Last Day of Classes
OCT 07	Mid-Check Grades Due	DEC 10	Prep Day
OCT 07-08	Fall Break (No Classes)	DEC 15, 2PM	Final Exam

Engagement Policy

There is no doubt we are in very unusual times. I appreciate all of you continuing your education despite the obstacles that we all are facing. I hope none of us gets sick, I also hope no one close to us gets sick, but I am prepared to work with anyone that may need to miss lecture or assignments due to COVID-19 or any other serious issue. I encourage you to reach out to me as soon as any issue arises so we can work out a plan to keep you up to speed and allow you to finish the course.

To this end, I will make use of TopHat to encourage engagement and take attendance, as well as to provide a space for you to collaborate with each other. Attendance will be taken at each class, as well as seats will be assigned according to WVU Policy. **The join code for TopHat is 361402.**

Assignment Policy

All assignments are due at the beginning of the assigned period, including electronically submitted material. Make-up exams and late assignments will **NOT** be accepted without **prior approval granted at least 2 days before the due date** from the instructor, consistent with WVU policies. Neat work is expected on all material submitted for grading (i.e. have to be able to read it to grade it). **Multiple sheets must be stapled, problems in the order assigned, and name and mailbox number must be on top of first page.** You may use engineering problem paper or standard notebook paper, but NOT scratch paper or paper torn from a spiral notebook and write on only one side of each page. All assignments turned in for grading must be your own individual work; copying homework is unethical.

Additional Exam Policy:

The following guidelines are imposed during every exam in MAE 215:

1. Absolutely **NO WIRELESS COMMUNICATION DEVICES** can be used during testing.
2. Exams are "closed book and notes".
3. Students must maintain one empty seat between themselves and their neighbors (exceptions may be made if space is unavailable).
4. All midterm exams must be returned to the instructor and/or proctor by 12:55 pm; all final exams must be returned within the allotted two-hour exam period (exceptions will of course be made for students with documentation of additional requirements).

Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the [West Virginia University Academic Integrity Policy](#)

(<https://provost.wvu.edu/governance/academic-standards-resources/academic-integrity-policy>). Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

Statler College Policy of Academic Integrity

(Approved by the Statler College Academic Standards Committee, 28 March 2019)

Case	Violation	Penalty
1	Cheating or plagiarism on minor course element (e.g., quiz, weekly lab report, homework as specified in the syllabus)	Report of academic dishonesty Grade of zero on the entire minor course element Possible one-letter reduction in final grade
2	Cheating or plagiarism on a major course element (e.g., exam, project)	Report of academic dishonesty Grade of zero on the entire major course element Possible additional one-letter reduction in final grade Possible UF [†] recommendation Possible exclusion from further participation in class
3	Collusion on major course element	Report of academic dishonesty Exclusion from further participation in class Failure in the course Recommendation for UF [†]
4	Other (document alteration, tampering with records, etc.)	Report of academic dishonesty Grade of zero on the entire major course element Possible additional one-letter reduction in final grade Possible failure in the course Possible exclusion from further participation in class Possible UF [†] recommendation
<p>* Dismissal from Statler College is permanent for Academic Integrity violations. Student conduct violations can be considered in dismissal. [†] UF - Unforgivable F Grade; cannot be replaced under D-F repeat policy. [‡] Separable sanctions (e.g., dismissal from Statler College, suspension, or expulsion from WVU) will be recommended for aggravated or second AI offenses. [§] Warning letters may be issued from the Statler College or the WVU Office of Student Conduct.</p>		
Sanctions will be assessed at the instructor and at the college/university levels. Additional sanctions may be assigned at the level of the instructor, college, and/or university.		
FORBIDDEN on Exams and Quizzes: The use of programmable calculators or smart devices (including smart-phones, smart watches, tablets, cameras, wearable devices, etc.) is prohibited unless specifically indicated by the instructor.		

Adverse Weather Statement

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact your instructor as soon as possible. Similarly, if your instructor(s) are unable to reach the class location, they will notify you of any cancellation or change as soon as possible, using WVU MIX email to prevent students from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, instructors will make allowances relative to required attendance policies, as well as any scheduled tests, quizzes, or other assessments.

Appropriate Use of Technology Statement

Use of technology in the classroom should always be directly related to class activities and/or course learning outcomes. Inappropriate technology use can be an impediment to learning and a distraction to all members of the class. As such, inappropriate use of technology in the classroom may be considered a disruption of the class and constitute a violation of the [WVU Student Conduct Code](#) and could potentially result in a referral to the Office of Student Conduct. Use of technology in the classroom when specifically prohibited by the instructor may also constitute a violation of [WVU's Academic Integrity](#) policy.

Campus Safety Statement

The WVU Police are committed to creating and maintaining a safe learning environment for all students, faculty, and staff. Part of this mission includes educating the campus community on how to respond to potential campus threats, such as the threat of an active shooter on campus or other suspicious behaviors. Fortunately, WVU Police offer training - both online and in-person - on how to handle a variety of campus safety scenarios. All students are encouraged to visit the [WVU Police webpage](#), in particular the content under the [Active Shooter](#) training program. Students are also encouraged to report any suspicious behaviors on campus using the [Report a Threat](#) portion of the webpage. Additional materials on campus safety prepared by WVU Police, including special safety tips and training, will also be provided on our eCampus page. [adopted 10-2-17]

Notice of Class Recording Policy

Meetings of a course at West Virginia University (WVU), whether online or in-person, may be recorded. Recordings are not guaranteed, and are intended to supplement the planned class session. Recordings will be made available to class participants, which may include students, assistants, guest lecturers, and co-facilitators. Recordings may be shared by the instructor or institution in accordance with WVU Rules and policies. The Recordings are owned by and contain intellectual property of WVU. The Recordings may not be shared, copied, reproduced, redistributed, transferred, or disseminated in any form or by any means without the prior written consent of authorized officials of WVU.

COVID-19 Statement

WVU is committed to maintaining a safe learning environment for all students, faculty, and staff. Should campus operations change because of health concerns related to the COVID-19 pandemic, it is possible that this course will move to a fully online delivery format. If that occurs, students will be advised of technical and/or equipment requirements, including remote proctoring software.

In a face-to-face environment, our commitment to safety requires students, staff, and instructors to observe the social distancing and personal protective equipment (PPE) guidelines set by the University at all times. While in class, students will sit in assigned seats when applicable and wear the required PPE. Should a student forget to bring the required PPE, PPE will be available in the building for students to acquire. Students who fail to comply will be dismissed from the classroom for the class period and may be referred to the Office of Student Conduct for further sanctions.

If a student becomes sick or is required to quarantine during the semester, they should notify the instructor. The student should work with the instructor to develop a plan to receive the necessary course content, activities, and assessments to complete the course learning outcomes.

Sale of Course Material Statement

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other course materials provided to students for their courses are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the [Student Conduct Code](#). (<https://studentconduct.wvu.edu/campus-student-code>) [adopted 5-11-2015]

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with [the Office of Accessibility Services](#). (<https://accessibilityservices.wvu.edu/>)

More information is available at the [Division of Diversity, Equity, and Inclusion](https://diversity.wvu.edu/) (https://diversity.wvu.edu/) as well.

Sexual Misconduct Statement

West Virginia University does not tolerate sexual misconduct, including harassment, stalking, sexual assault, sexual exploitation, or relationship violence [[BOG Rule 1.6](https://policies.wvu.edu/finalized-bog-rules/bog-governance-rule-1-6-rule)] (https://policies.wvu.edu/finalized-bog-rules/bog-governance-rule-1-6-rule). It is important for you to know that there are resources available if you or someone you know needs assistance. You may speak to a member of university administration, faculty, or staff; keep in mind that they have an obligation to report the incident to the [Title IX Coordinator](https://titleix.wvu.edu/staff). (https://titleix.wvu.edu/staff)

If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the [Carruth Center](#), **304-293-9355** or **304-293-4431** (24-hour hotline), and locally within the community at the [Rape and Domestic Violence Information Center](#) (RDVIC), **304- 292-5100** or **304-292-4431** (24-hour hotline).

For more information, please consult [WVU's Title IX Office](https://titleix.wvu.edu/confidential-resources) (https://titleix.wvu.edu/confidential-resources).

Disclaimer

The instructor reserves the right to deviate from the syllabus when a change is in the best interests of the class, as determined by the instructor.

Period(s)	Total	Date(s)	L,E,R,S,B	Description	Ch.
1	1	08/18	L	Introduction, historical notes	1
1	2	08/20	L	Engineering fundamentals	1
1	3	08/23	L	Units	2
1	4	08/25	L	State equation	2
2	5 – 6	08/27 – 08/30	L	Moving gases	2
2	7 – 8	09/01 – 09/03	L	Orbital mechanics, escape velocity, conic sections	3
N/A		09/06	B	Labor Day	N/A
2	9 – 10	09/08 – 09/10	L	Standard atmosphere	3
1	11	09/13	L	Steady vs. unsteady flows	4
1	12	09/15	L	Continuity	4
1	13	09/17	R	Exam Review	1 - 3
1	14	09/20	E	Exam I and CC Topics 3,4,5,6,14,15	1 - 3
2	15 – 16	09/22 – 09/24	L	Momentum	4
2	17 – 18	09/27 – 09/29	L	Euler & Bernoulli	4
2	19 – 20	10/01 – 10/04	L	Energy	4
1	21	10/06	L	Isentropic relations	4
N/A		10/08	B	Fall Break	N/A
1	22	10/11	S	SolidWorks Demo	N/A
1	23	10/13	L	Dimensional analysis, Buckingham Pi	4
1	24	10/15	L	Common Dimensionless Quantities	4
2	25 – 26	10/18 – 10/20	L	Drag on bodies in flow	4
1	27	10/22	R	Exam Review	4
1	28	10/25	E	Exam II and CC Topics 7,8,9,10,17	4
1	29	10/27	L	Conventional aircraft basics	5
2	30 – 31	10/29 – 11/01	L	Airfoils	5
2	32 – 33	11/03 – 11/05	L	Finite wings, High-lift devices	5
2	34 – 35	11/08 – 11/10	L	Computational airfoil analysis, XFLR5	5
1	36	11/12	L	Orientation, propulsion	6
1	37	11/15	R	Exam Review	5
1	38	11/17	E	Exam III and CC Topics 1,2,11,12,13,16	5
1	39	11/19	L	Endurance & range	6
N/A		11/22 – 11/26	B	Fall Recess	N/A
1	40	11/29	L	Takeoff & landing distance	6
1	41	12/01	L	Banking and service ceiling	6
2	42 - 43	12/03 – 12/06	R	Final Exam review	1 – 6
1	44	12/08	S	Glider Fly-off	N/A
N/A	N/A	12/15	E	Final Exam, 2:00 PM – 4:00 PM	1-6

MAE 215 List of Critical Competency Topics

1. Basic geometry (determination of main characteristic elements – area, side, radius, height, angles, etc...) applied for main aircraft components, such as wing planform or fuselage cross-sections.
2. Basic trigonometry (definition and simple manipulation of trigonometric functions) applied for determining aircraft performance characteristics.
3. Definition and calculation of integrals and derivatives of simple functions.
4. Vectors and operations with vectors (definition, magnitude, algebraic sum, vector components with respect to coordinate systems) applied to aerodynamic forces, moments, and aircraft linear and angular velocity.
5. Basic units (significance, normalization, conversion) of physical variables relevant to AE.
6. Manometer (description, functionality, calculation of pressure).
7. Conservation of mass principles.
8. Linear momentum theorem for fluids.
9. Conservation of energy principles.
10. Isentropic flow principles.
11. Aerodynamic forces and moments (definitions, main characteristics, coefficients, angle of attack, lift and drag curves, main parameters).
12. Airfoil and wing characteristics and basic properties (nomenclature, chord, thickness, camber, symmetry, infinite vs. finite wing).
13. Reference frames and coordinate systems (body axes, wind axes, Earth axes).
14. Universal laws of gravity.
15. Standard atmosphere and constituents of atmospheric air.
16. Boundary layer basic characteristics.
17. Steady vs. unsteady flow (definitions, basic meaning).