

Aerospace Engineering/College of Engineering

AerE 421 – Advanced Flight Structures

Fall 2018 Syllabus

**Instructor: Dr. Vinay Dayal, Associate Professor, 2353 Howe Hall,
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**Section 1: Class: *MW 9:00-9:50 Howe 2202 F 9:00-10:50 Howe
2202/Howe 2344***

Course Information

Description

AER E 421. Advanced Flight Structures.

(2.5-1) Cr. 3. S. *Prereq: AER E 321, MATH 266 or MATH 267*

Analysis of indeterminate flight structures including finite element laboratory. Static analysis of complex structural components subject to thermal and aerodynamic loads. Analytical and finite element solutions for stresses and displacements of membrane, plane stress, plate structures. Buckling of beams, frames, and plate structures. Introduction to vibration of flight structures. Steady state and transient structural response using normal modal analysis.

Student Learning Outcomes/Objectives

Outcomes of AerE421: **You will be a structures Engineer**

1. Students will be able to take an idealized wing and do a full analytical analysis
2. Students will be able to use a layered element to model composites in FEA.
3. Students will be able to identify the necessity of a nonlinear analysis based on linear analysis.
4. Students will know the type of element to use in 1D, 2D and 3D analysis.
5. Students will be able to calculate the minimum buckling load of a structure.
6. Students will be able to extract the natural frequencies and mode shapes
7. Students will be able to follow a good engineering process
 - a. Identify the problem

- b. Choose correct analysis method
- c. Use appropriate simplifications for structure, loads and boundary conditions
- d. Choose appropriate materials
- e. Examine the validity of the solution

Prerequisite or Co-requisite

- AER E 321: Flight Structures Analysis
- MATH 266: Elementary Differential Equations
or MATH 267: Elementary Differential Equations and Laplace Transforms

Textbook

Introduction to Aircraft Structures for Engineering Students 42nd Ed., T.H.G. Megson

Topic Outline/Schedule

		2018	Topic	Book Chapter	Problem Topic
M	8	Jan	Principle of Virtual Work	4.1,4.2	
W	10	Jan	Pr of total potential energy-2 force members	12.1,12.2	
F	12	Jan	Introduction to ANSYS-gui	Notes	
M	15	Jan	NO classes		
W	17	Jan	Joining of 2 Force Members		
F	19	Jan	2D Frames, example	Notes	Beam Problem
M	22	Jan	Beam ANSYS	Notes	
W	24	Jan	Stiffness matrix for beams, 2D structures	12.7,12.8	
F	26	Jan	Finite Element 2-D structures	12.8	2D plate problem
M	29	Jan	Composite Materials Intro	Notes	
W	31	Jan	Composites Micromechanics	13.1-13.2	
F	2	Feb	First Mid Term Test		
M	5	Feb	Composite Macromechanics	Notes	
W	7	Feb	Composite Macromechanics	Notes	
F	9	Feb	Composite Design/ANSYS	Notes	Canard Problem
M	12	Feb	Structural idealization	19.1,19.2,19.3	
W	14	Feb	Shear of open section beams	19.3.2	
F	16	Feb	Modelling in ANSYS 2-D/3-D structures	Notes	3-D problem beam
M	19	Feb	Shear of closed section beams	19.3.3	

W	21	Feb	Deflection of open and closed section beams	19.4	
F	23	Feb	ANSYS APDL		ANSYS APDL
M	26	Feb	Fuselage	21.1,21.2	
W	28	Feb	Wings	22.1,22.2,22.3,	
F	2	Mar	Wings	22.3,22.4	Idealized beam
M	5	Mar	Second Mid-Term Test		
W	7	Mar	Cut-Outs in fuselage, and Wings	21.4,22.8	
F	9	Mar	Non-linear analysis, geometric, material	Notes	Nonlinear problems
	12-16	Mar	Spring Break		
M	19	Mar	Energy methods for columns	8.5	
W	21	Mar	Flexural Torsional buckling	8.6	
F	23	Mar	Buckling Lab		Column buckling
M	26	Mar	Buckling of plates	9.1	
W	28	Mar	Instability of stiffened panels	9.5	
F	30	Mar	Plate Buckling solution		Plate buckling
M	2	Apr	Tension Field beams	9.7	
W	4	Apr	Introduction to Vibrations	Notes	
F	6	Apr	Vibration using FEA methods	Notes	No lab
M	9	Apr	ANSYS analysis of vibrations	Notes	
W	11	Apr	Vibration of bars	Notes	
F	13	Apr	Modal Analysis of vibrations	Notes	Vibration by ANSYS
M	16	Apr	Harmonic Response	Notes	
W	18	Apr	Forced Response	Notes	
F	20	Apr	Forced Response	Notes	Harmonic analysis
M	23	Apr	Project		
W	25	Apr	Project		
F	27	Apr	Project		
T	2	May	Final Exam 7:30 to 9:30	Tentative	

Grading Policy

Percentage	Description
15%	Exam 1
15%	Exam 2
30%	Assignments
20%	Final Project

20%	Final Exam
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Letter Grade	Percentage	Performance
A	92-100%	Excellent Work
A-	89-91.99%	Nearly Excellent Work
B+	86-88.99%	Very Good Work
B	81-85.99%	Good Work
B-	79-80.99%	Mostly Good Work
C+	76-78.99%	Above Average Work
C	71-75.99%	Average Work
C-	69-70.99%	Mostly Average Work
D+	66-68.99%	Below Average Work
D	61-65.99%	Poor Work
F	0-60.99%	Failing Work

Grades will NOT be based on curve

Class-Policy

All assignments have to be turned in on the announced time. No late submissions unless approved in advance.

All assignments will be promptly graded and returned. Resubmission is allowed on the following class time. You can earn up to 50% of the lost points.

Please come to the class on time. Do not disturb the class by late arrivals.

No internet accessible cellphones, laptops, computers, calculators allowed during the tests. If found using any of these during exams, the gadgets can be confiscated till the end of the exams.

Academic Dishonesty

The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

<http://www.dso.iastate.edu/ja/academic/misconduct.html>

Disability Accommodation

Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate

needing accommodations in this course, please contact (instructor name) to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with (instructor name), you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email disabilityresources@iastate.edu . Retroactive requests for accommodations will not be honored.

Dead Week

This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook
<http://www.provost.iastate.edu/resources/faculty-handbook> .

Harassment and Discrimination

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

Religious Accommodation

If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

Academic Issues

If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu