AEEM 3042
Aircraft Performance & Design
Spring Semester 2023

UNIVERSITY OF Cincinnati

AEEM 3042 – Aircraft Performance & Design

Instructor - Mark Fellows

B.S. Aerospace Engineering, UC Class of 1980
M.S. Aeronautical Engineering, AFIT Class of 1985
Aerospace MBA, UTenn Class of 2009

Robert – B.S. Aerospace Engineering, UC Class of 2011
Amanda – M.S. Aerospace Engineering, UC Class of 2011

36 year career at Wright-Patterson AFB
Aircraft Performance Engineer
Air Vehicle Team Leader

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Teaching Assistant

Keerthan Ganeshan, Graduate Student
ganeshka@mail.uc.edu

Class of 2020, B.S. Aeronautical Engineering
Nitte Meenakshi Institute of Technology (NMIT)
Bangalore, India

UC Aerospace Engineering M.S. Program
(Fluids and Propulsion)

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Class Day / Time / Location

Tuesdays & Thursdays 3:30 – 4:50 p.m. in 544 Baldwin Hall
University closures – we will meet over Zoom

Communication

E-mail: fellowmk@ucmail.uc.edu (anytime)
Phone: (937) 469-1934 (10 a.m. – 11 p.m.)
Office Hours: Tuesdays and Thursdays after class 5:00 to 5:45 p.m.
in 828 Old Chem

Textbook

"Aircraft Performance and Design" by John D. Anderson, Jr

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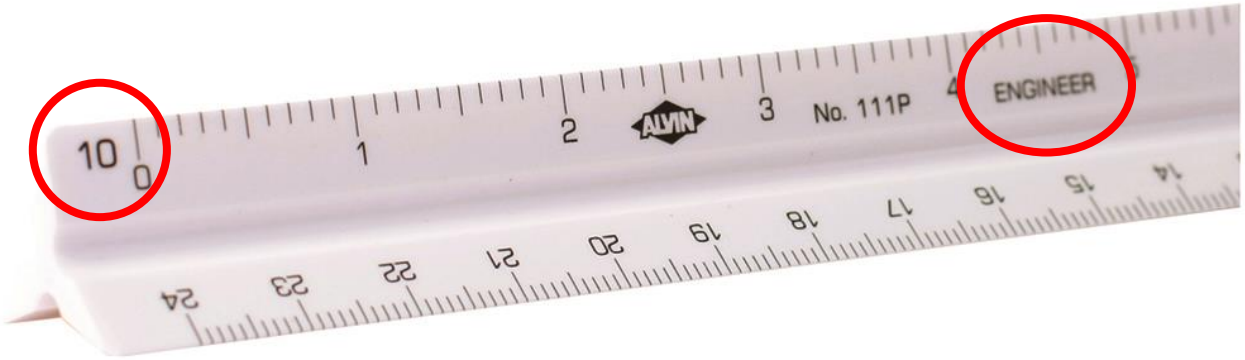
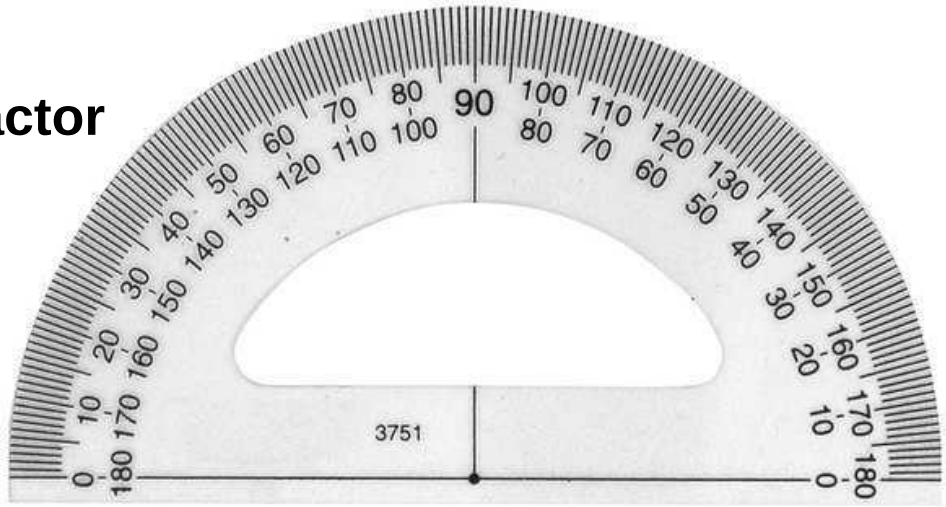
Class Materials

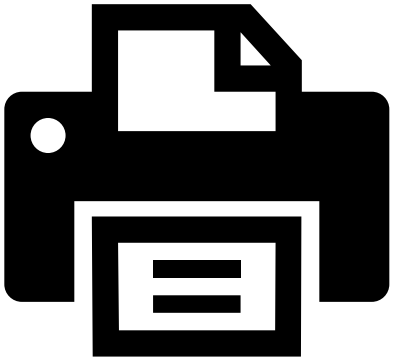
Engineering Scale



Protractor



Access to a Printer



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What is Integrated Aircraft Engineering?

Integrated = combining two or more technical disciplines

Aircraft = total system performance

Engineering = application of mathematics, physics, and practical knowledge in order to design and analyze complex systems

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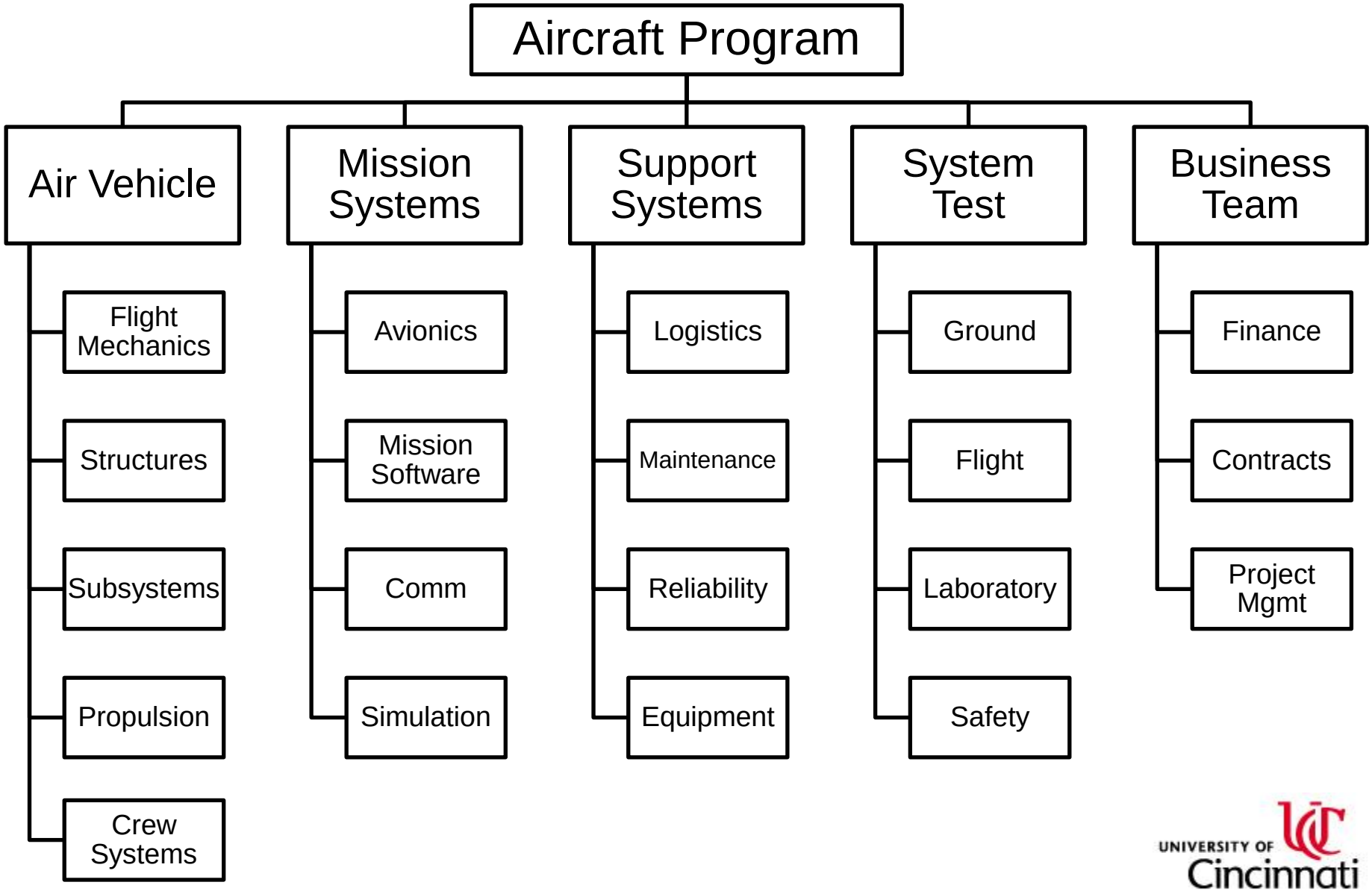

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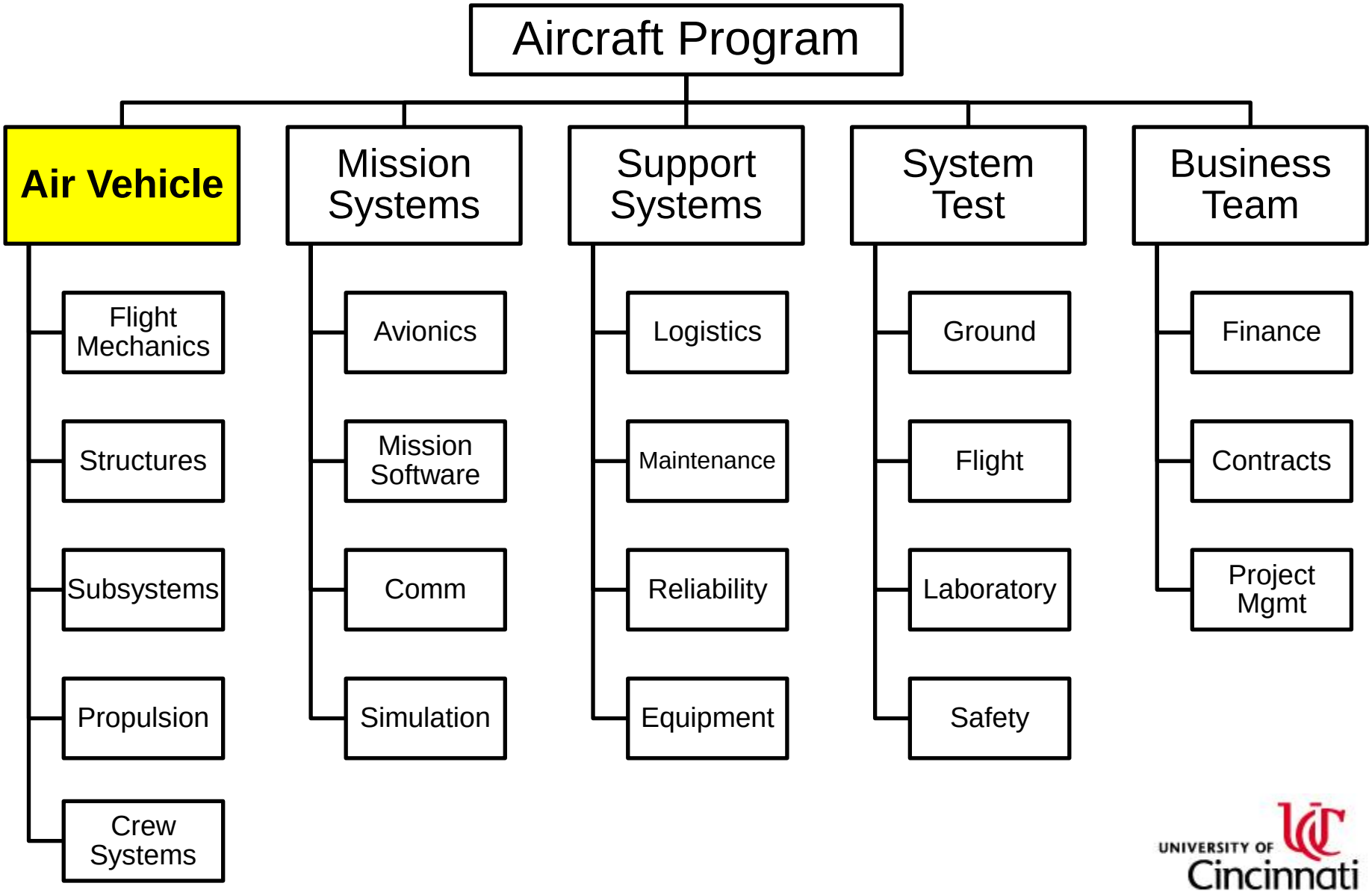

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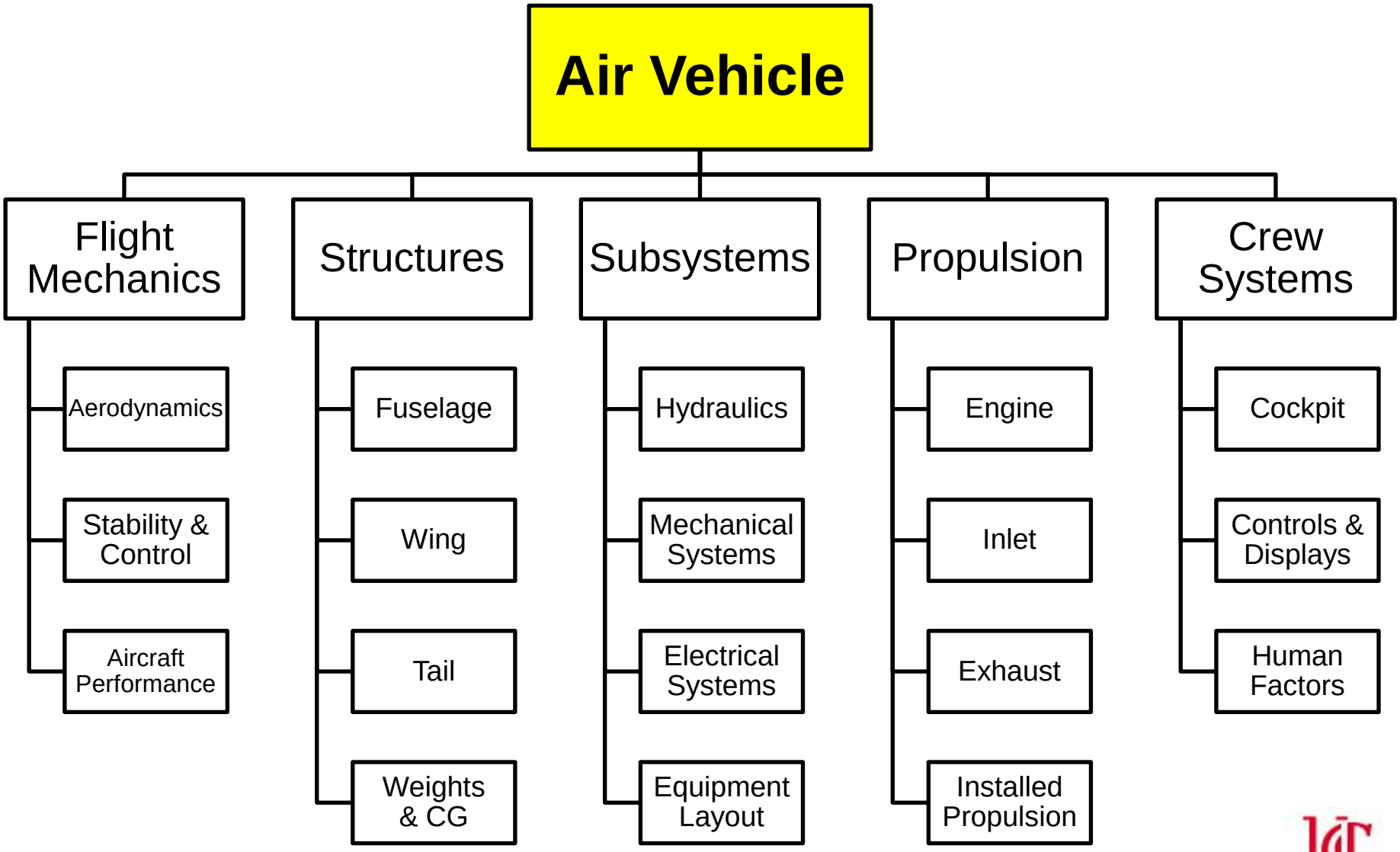

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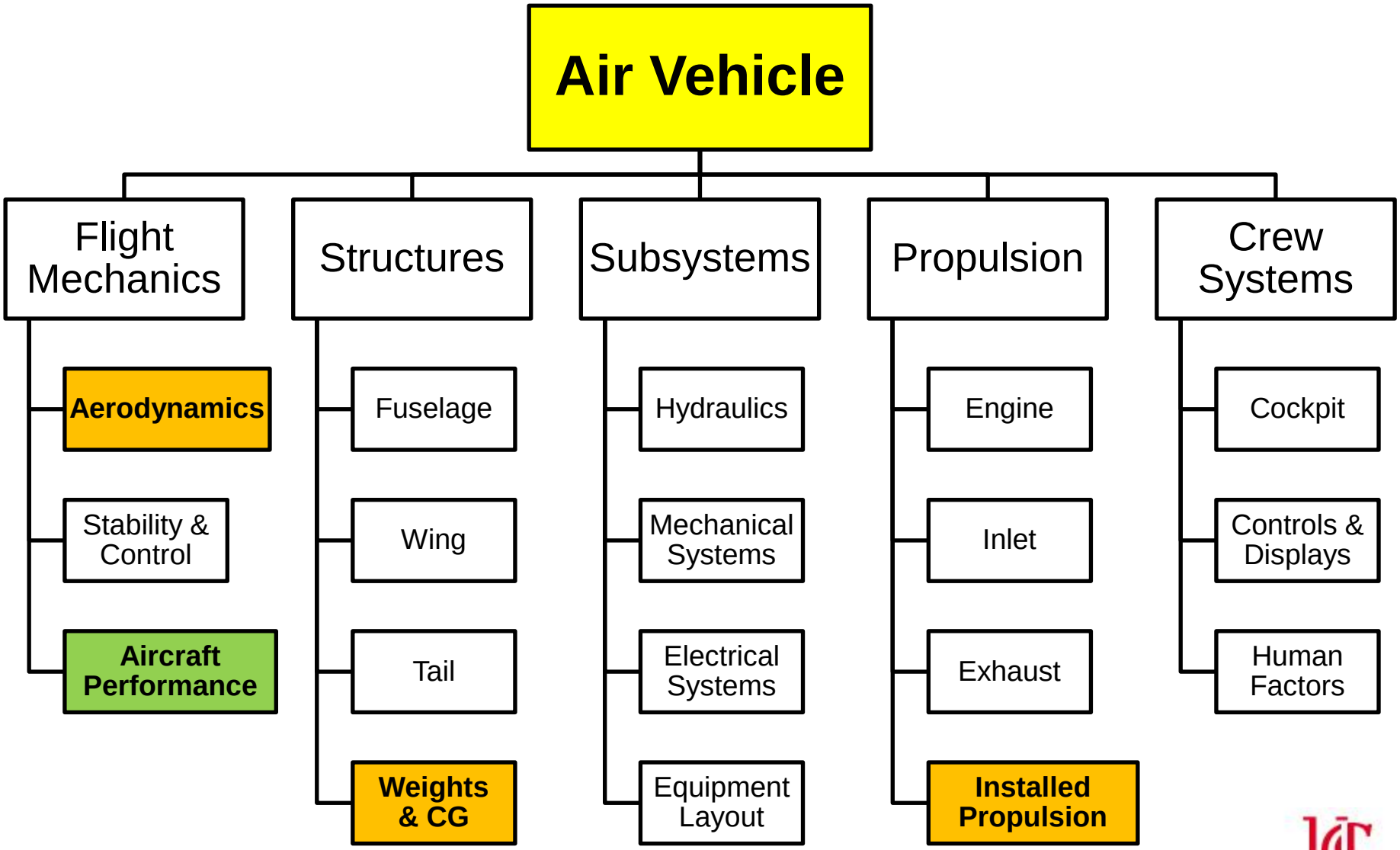

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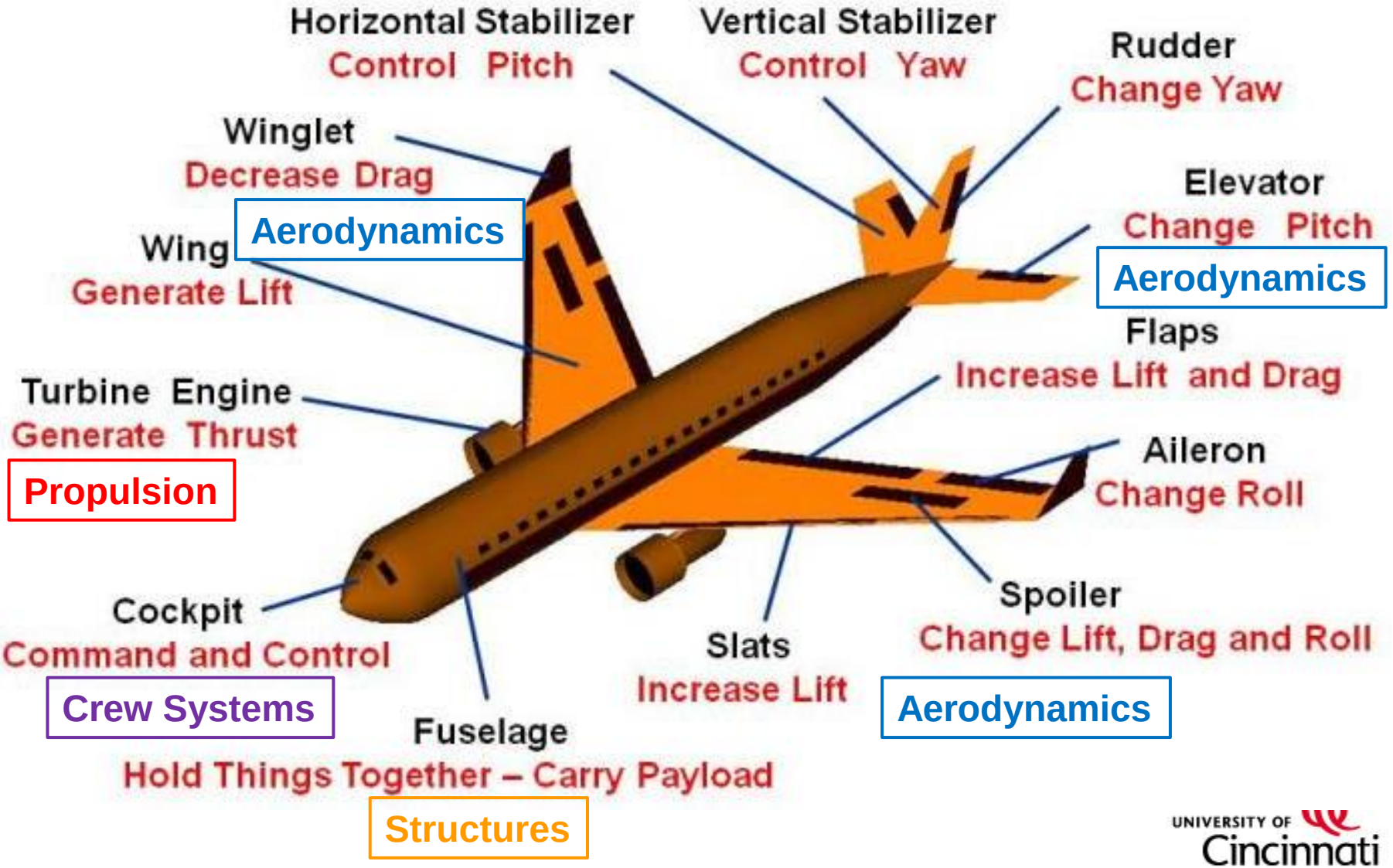

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My Career

1976 – 1979: Co-op student at Wright-Patterson AFB

1980 – 1983: Aircraft Performance Engineer in home office

F-5, F-20, X-29, F-15

1983 – 1984: Aircraft Performance Engineer in F-15 SPO

F-15A/B/C/D, started F-15E

1986 – 1992: Aircraft Performance Engineer in ATF / F-22 SPO

YF-22, YF-23, F-22

1992 – 2002: Flight Mechanics Team Leader in JAST / JSF / F-35 SPO

X-31, X-32, X-35, F-35

2002 – 2006: Air Vehicle Team Leader in J-UCAS SPO

X-45A, X-45C, X-47B

2006 – 2012: Air Vehicle Team Leader on Classified Program

2014 – present: Adjunct Professor, UC Aerospace Engineering

Aircraft Design I / II Capstone, Aircraft Performance and Design

Advanced Aircraft Performance (Technical Elective - seniors)

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My Career

1980 – 1983: Aircraft Performance Engineer in home office

F-5, F-20, X-29, F-15

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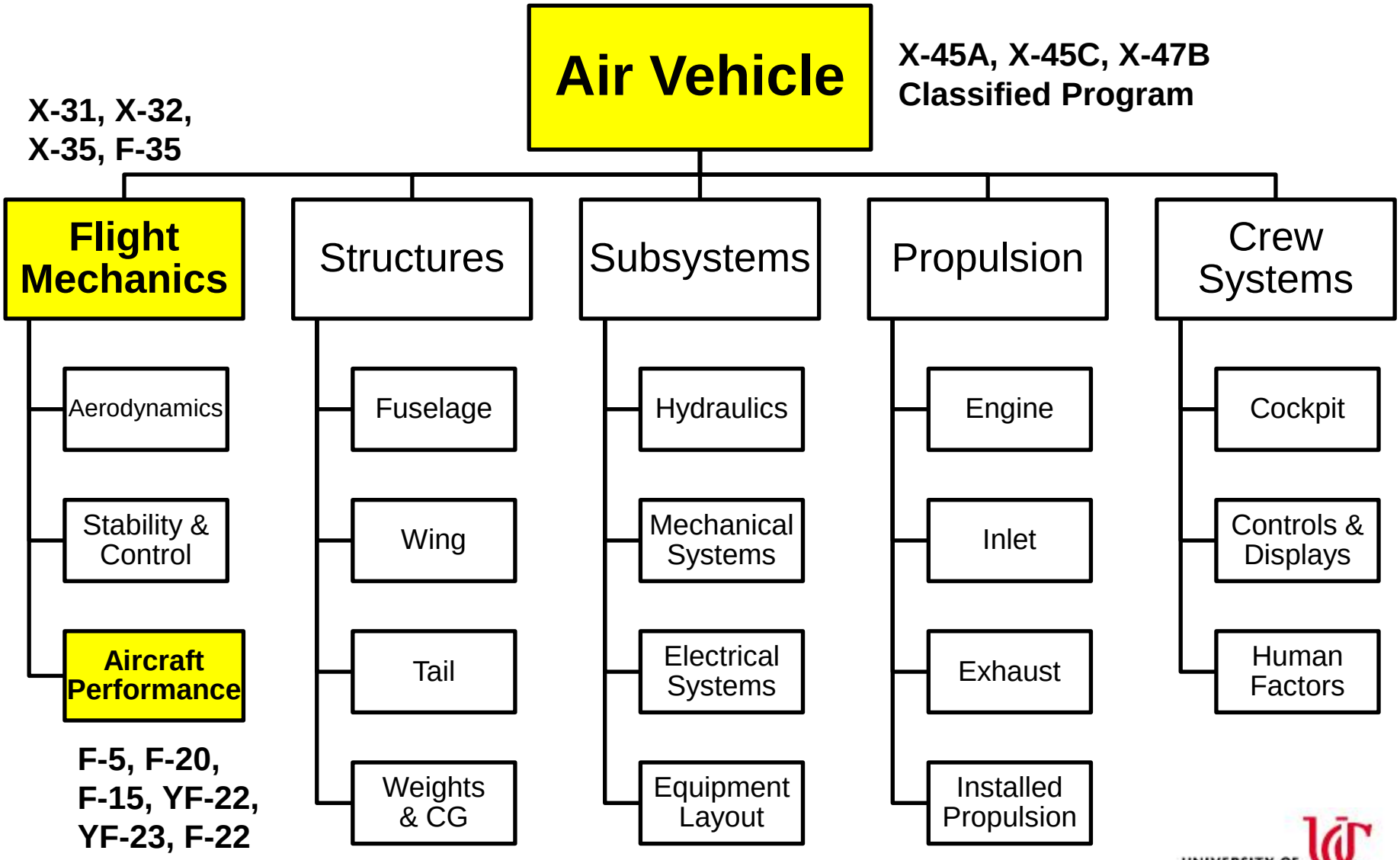

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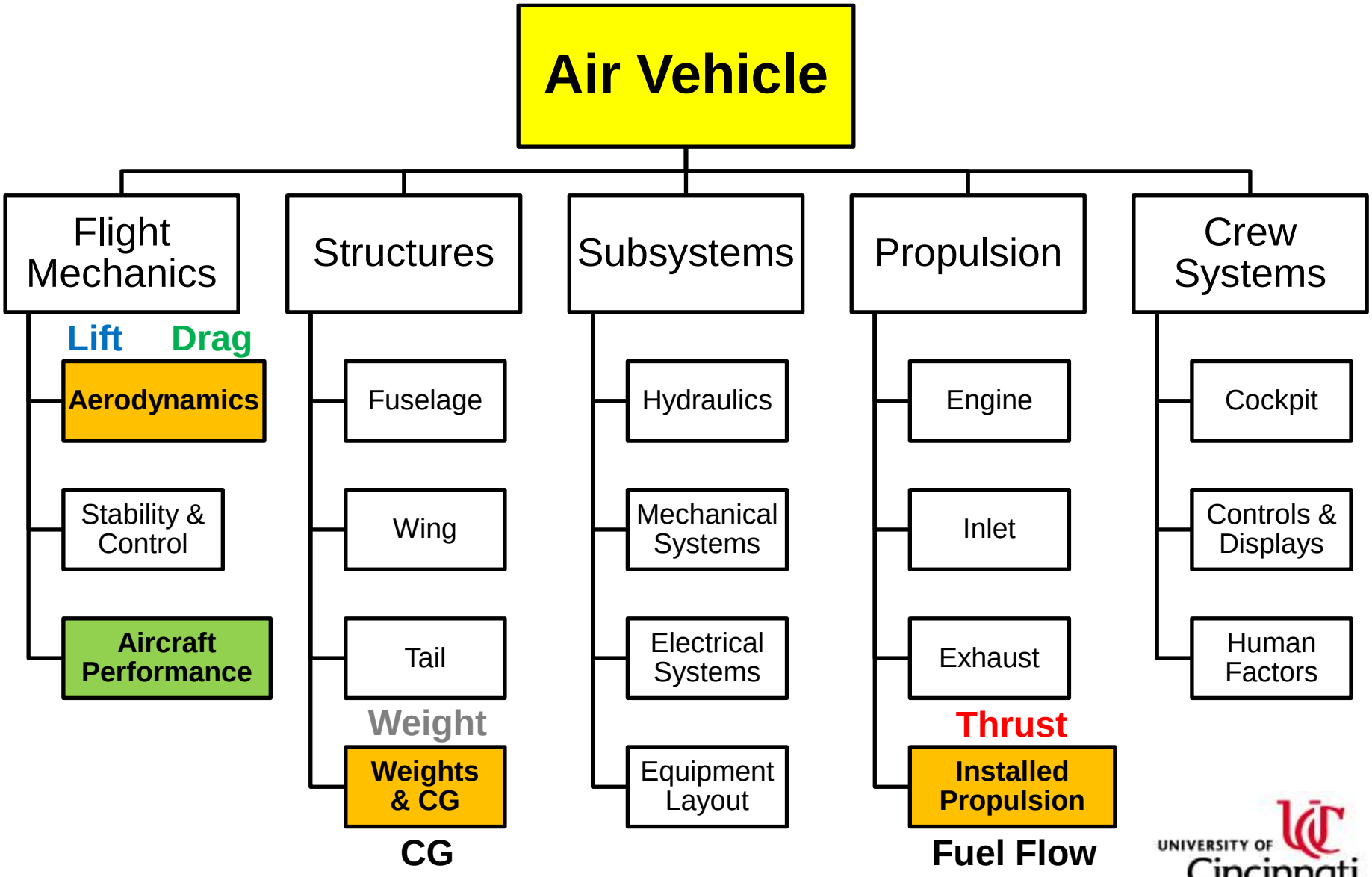

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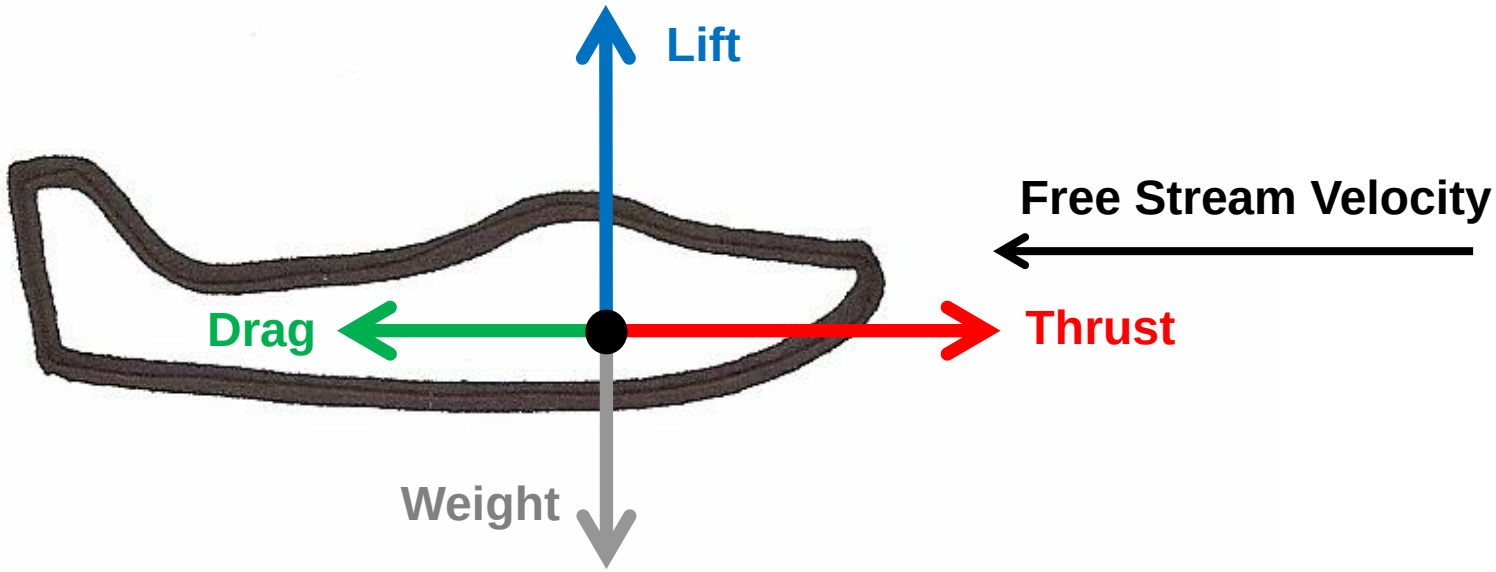
Simple Free Body Diagram



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Aircraft Performance

Knowing these parameters, we can determine the answers to these questions:

- How fast can it fly?
- How high can it fly?
- How far can it fly?
- How fast can it climb?
- How quickly can it turn?
- What runway length is needed for takeoff and landing?

Aircraft Performance

Calculations that we will be doing:

- Flight Envelope
- Climb / Descent
- Acceleration / Deceleration
- Instantaneous & Sustained Turn
- Cruise / Loiter
- Mission Range / Radius
- Takeoff / Landing Distance

Class Schedule

Block 1 – Ingredient Data

- Aerodynamics — Chapter 2
- Propulsion — Chapter 3
- Aircraft Weights

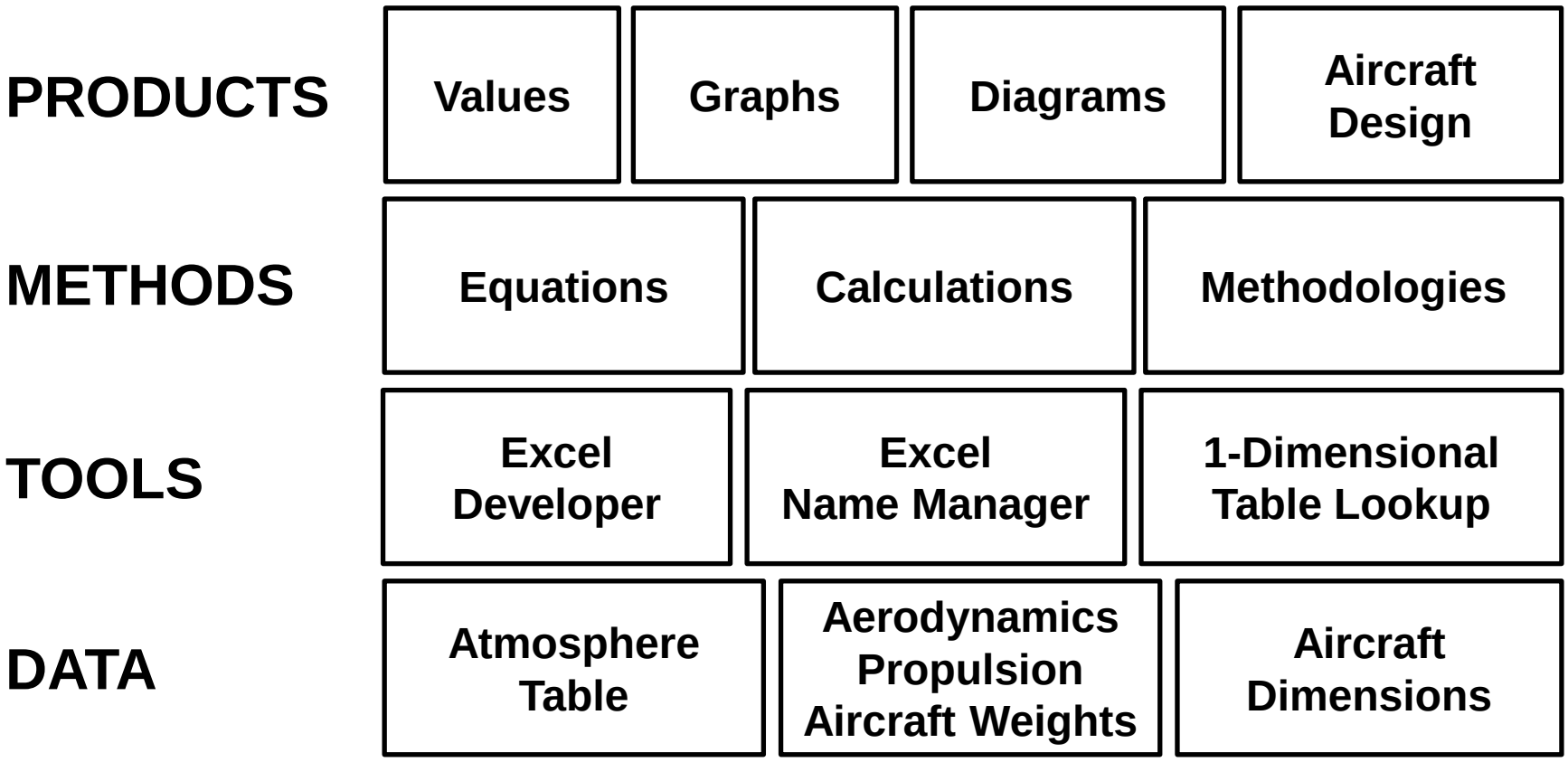
Block 2 – Aircraft Performance

- Equations of Motion — Chapter 4
- Steady Flight — Chapter 5
- Accelerated Flight — Chapter 6

Block 3 – Aircraft Design

- Philosophy of Aircraft Design — Chapter 7
- Design of Aircraft (Propeller) — Chapter 8
- Design of Aircraft (Jet) — Chapter 9

Building Blocks



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Course Schedule – Blocks

Block	Weeks	Dates	Topics
1	1 - 3	Jan 9 – Jan 27	Ingredient Data
2a	4 - 6	Jan 30 – Feb 17	Steady State Performance
2b	7 - 9	Feb 20 – Mar 10	Accelerated Performance
3a	10 - 11	Mar 20 – Mar 31	Aircraft Design Process
3b	13 - 15	Apr 3 – Apr 20	Aircraft Design

Block 1 Schedule – Ingredient Data

Week	Day	Date	Topics	Homework Assigned
1	Tuesday	Jan 10	Introduction Atmosphere	Chapter 1 Reading Atmosphere Model
	Thursday	Jan 12	Physics of Flight Aircraft Terms	Aircraft Dimensions Quiz #1
2	Tuesday	Jan 17	Aerodynamics	Chapter 2 Reading Aerodynamics
	Thursday	Jan 19	Propulsion Aircraft Weights	Chapter 3 Reading Propulsion Aircraft Weights Quiz #2
3	Tuesday	Jan 24	Material Review Homework Review	
	Thursday	Jan 26	Exam #1	

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Block 2a Schedule – Steady Flight

Week	Day	Date	Topics	Homework Assigned
4	Tuesday	Jan 31	Exam #1 Review Num Methods Flight Envelope	Chapter 4 Reading Atmos Table Lookup Flight Envelope
	Thursday	Feb 2	Thrust Required Range Endurance	Chapter 5-1 Reading Thrust Required Range & Endurance Quiz #3
5	Tuesday	Feb 7	Energy Concepts Min & Max Velocities	Chapter 5-2 Reading Energy & P_s Min & Max Velocities
	Thursday	Feb 9	Rate of Climb Ceilings	Chapter 5-3 Reading Rate of Climb Ceilings Quiz #4
6	Tuesday	Feb 14	Material Review Homework Review	
	Thursday	Feb 16	Exam #2	

Block 2b Schedule – Accelerated Flight

Week	Day	Date	Topics	Homework Assigned
7	Tuesday	Feb 21	Exam #2a Review Climb & Accel TFD	Climb & Accel TFD
	Thursday	Feb 23	Energy, P_s, Turning	Chapter 6-1 Reading Maneuver
8	Tuesday	Feb 28	Takeoff Landing	Chapter 6-2 Reading Airfield Quiz #5
	Thursday	Mar 2		
9	Tuesday	Mar 7	Material Review Homework Review	
	Thursday	Mar 9	Exam #3	

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Course Grading

3% Quiz #1
3% Quiz #2
10% Exam #1
3% Quiz #3
3% Quiz #4
10% Exam #2
3% Quiz #5
10% Exam #3
15% Project #1
15% Project #2
25% Homework Assignments

Quiz Time is limited to 30 minutes
5 attempts permitted
Will cover concepts
Taken via Canvas & due with HW

Exam Time is limited to class time
Will need a calculator for calculations
Taken via Canvas in our classroom

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Homework Assignments (25%)

Will be posted and submitted online via Canvas

Homework assigned on Tuesdays and Thursdays
are due by 11:59 pm ET on Monday night

Each Homework Assignment is worth 1% of your final grade

Helps the students understand the calculations & prepare for exams

Weekly Schedule:

Tuesday	HW assigned during class
Thursday	HW assigned during class
Monday	HW Help Session 4:00 to 5:00 pm ET (proposed)
	HW & Quiz due by 11:59 pm ET

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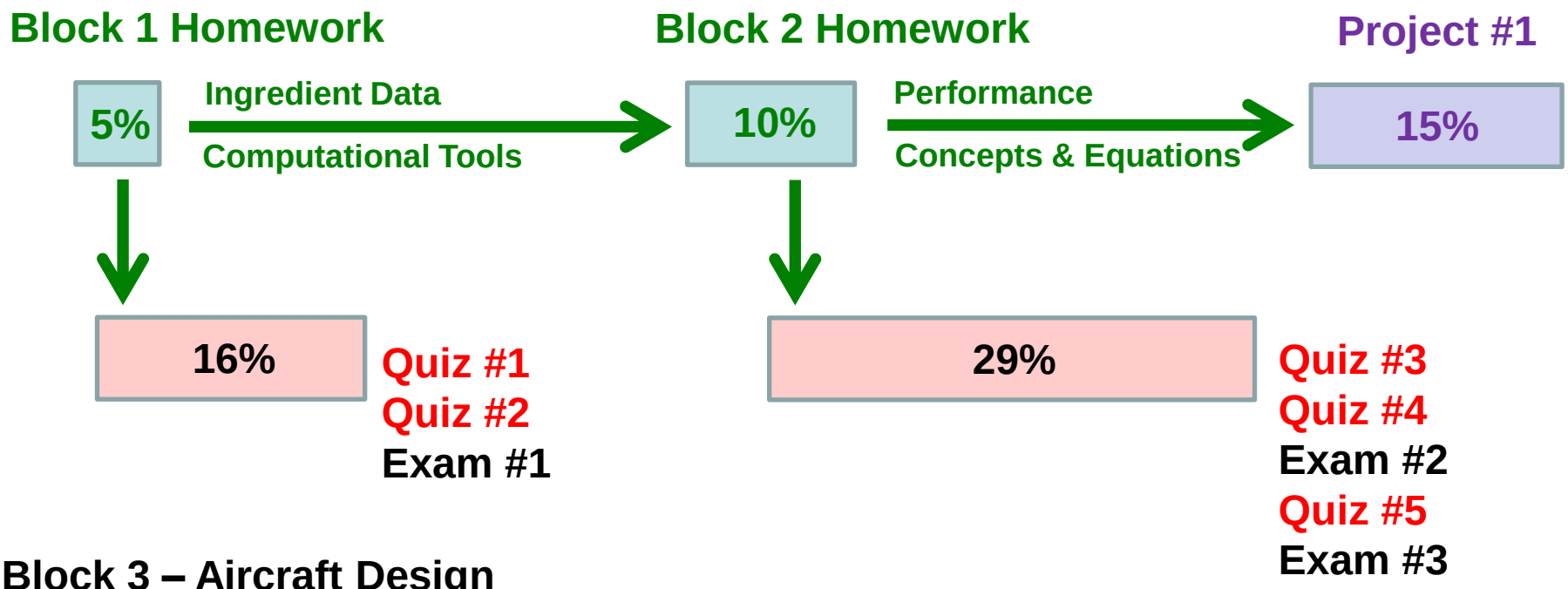
Course Flow Diagram

Blocks 1 & 2 – Aircraft Performance



Block 3 – Aircraft Design

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How can I get a good grade in this class?

Be present for all class sessions

Pay attention in class (put away your cell phones!)

Read and study the assigned sections in the textbook

Do your homework

Follow the instructions!

Be prepared for the tests

THIS IS A FAST-PACED COURSE! DON'T FALL BEHIND!

Helpful Hints

Keep track of all of the important terms and understand what they mean

If you understand the material and the homework you will probably get a B or better

There will be one part on each test that will challenge your understanding of the material ... if you get that part right you could possibly get an A

Ask questions if you don't understand!!

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Pre-Junior Year

This is going to be a tough semester!!

Lots of engineering classes, homework, and projects

Students just turned 21 or will be turning 21 = lots of parties!

You will definitely get bogged down during this semester with concurrent activities, project deadlines, and tests

Weekly Time Management (168 hours)

Rule of thumb: 2 – 3 hours spent on homework and studying per 1 hour of classroom time

Weekly: 17 hours in class + 34 hours outside class = 51 hours (full time job!)

Gotta sleep!	8 hours x 7 days = 56 hours
Gotta eat!	3 hours x 7 days = 21 hours
Gotta have some fun!	Whatever is left over (40 hours)

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The “Iceberg Illusion”

Semester Grade

Establish Good Habits

Avoid Bad Results

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Helpful Advice

ALWAYS KEEP UP WITH YOUR CLASSES!

Schedule time for doing homework early in the day

Pay attention to how your time is spent

Do not procrastinate on tasks that need to get done

Do not leave assignments and projects until the last minute

(planned procrastination, the “Student Syndrome”, Parkinson’s Law)

Strategies

Pay attention to the syllabus and instructor announcements

Listen in class – there are occasional hints dropped

Use a daily planner

Stay one day ahead

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Class Expectations

Be present for all class sessions – this class will be FAST PACED and CALCULATION INTENSIVE!

Pay attention in class (put away your cell phones)

Get started early on your assignments! Do not procrastinate!

Prepare quality work for all homework, projects, and presentations

Turn in your assignments on time!

Academic Integrity

Do your own work (homework assignments and exams)

Cite sources (projects)

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Final Helpful Hints

Keep track of all of the important terms and understand what they mean

Understand each parameter's units and know how to convert

Learn the various computational techniques and use them

Follow the instructions!

"Even a fool, when he keeps silent, is counted wise."

~ Proverbs 17:28

"He who asks a question may appear as a fool for five minutes; he who does not ask a question remains a fool forever."

~ Chinese Proverb

Ask questions if you don't understand!!

Otherwise, I will assume that everyone understands the material

Homework Assignment

Reading – Chapter 1 in textbook

The student is encouraged to read certain chapters of the textbook that will augment the lecture material discussed in class

The textbook's author provides:
Historical perspectives
In-depth explanations for aircraft performance topics

Well worth reading!!!

Questions?