**AE 522**

**Aerospace Design II Lab**

**Course Outline and Requirements Spring 2024**

**1. General Items**

**1.1. Class Times & Conditions:**

* By Appointment per team and individual

**1.2. Instructor:** Dr. Ron Barrett-Gonzalez

adaptivebarrett@gmail.com, (785) 760-4614 (cell) 856-9969 (home)

Virtual Office Hours: TBD

Note that many days collisions with other meetings are bound to occur. Just get in touch with Dr. Barrett via e-mail or phone if that happens. If a review of notes is needed, a quick Zoom conference can often clear things up. So be at a terminal which can handle a quick conference (sound card, good screen etc.). Feel free to call Dr. Barrett during waking hours. Bedtime is generally around 11pm. If he *can* answer, he *will* answer. He generally switches from cell phone to land line after dinner.

GTA: None

**1.3. This Document Subject to Change!** Check https://www.aerodoc.tech/522 daily for updates as mission specifications may also be updated as well as due dates and assignment details.

**1.4. Textbook & References:** Students are asked to purchase Airplane Design by Jan Roskam, Parts I through VIII. Part I is especially important. Part II will be used a bit. Parts III - VIII will be used only as reference. Hard copies are running low. You can get them for e-readers from DARCorporation.com:

<https://shop.darcorp.com/index.php?route=product/product&product_id=59>

**1.5. Attendance and Participation**: The class will be taught live and in person. Every effort will be made to record classes, but that cannot be guaranteed. Students are always encouraged to participate to the fullest. If you have a question, don't sit on it, ask!

**1.6. Disabilities & Inclusion:** KU strictly observes the Americans with Disability act as well as principles of ethics, diversity and inclusion and takes these matters seriously.

From KU’s Diversity and Inclusion Statement <http://policy.ku.edu/provost/diversity-inclusion>

“As a premier international research university, the University of Kansas is committed to an open, diverse and inclusive learning and working environment that nurtures the growth and development of all. KU holds steadfast in the belief that an array of values, interests, experiences, and intellectual and cultural viewpoints enrich learning and our workplace. The promotion of and support for a diverse and inclusive community of mutual respect require the engagement of the entire university. The University of Kansas prohibits discrimination on the basis of race, color, ethnicity, religion, sex, national origin, age, ancestry, disability, status as a veteran, sexual orientation, marital status, parental status, gender identity, gender expression and genetic information in the University's programs and activities.”

Let Dr. Barrett know what name you prefer him to call you and if you are comfortable, what pronouns you prefer.

**1.7. Emergencies:** Dial 911

**1.8. Special Considerations Relating to COVID-19:** Follow National, State, Local and University guidelines. Of course, this is a highly fluid situation and is bound to change as the pandemic evolves. Go to [https://protect.ku.edu](https://protect.ku.edu/) for the latest guidance.

**1.9. Quizzes:** None currently scheduled. Note that this is subject to change.

**1.10. Reports:**  All reports will be constructed as a team for those students choosing to participate in the team competitions. With that said, the contributions of each individual author must be noted on each section of the report. 20% of students' grades will come from the team report score. 20% of students' grades will come from their individual section score. The reports must be turned in to the following address before the due date and time

kuaerodesign@gmail.com

There are no individual graduate-level design competitions. Only team projects will be supported.

Reports must be named as follows:

AE522\_Report#\_Teamname.doc *example: AE522\_Report1\_QuadRockets.doc*

AE522\_Report#\_Teamnamee.pdf *example: AE522\_Report1\_QuadRockets.pdf*

Students must submit their original .doc file (or file from the package that generated the document) along with a .pdf version of the report. The .pdf documents will be graded in detail.

**1.12. Submitted Report File Sizes and the Importance of Appendix A**

Each report must be under the prescribed sizes below. For each 100k of extra file size beyond the limits above, a penalty of 1% of the report value will be assessed. The limit of this penalty shall be 40% of the report value. The size of the file received by Dr. Barrett shall be the size of the file used for this assessment, NOT the size of the file sent. So check your file size by performing a test send to yourself. Note that many reports will include an Appendix A. This appendix is intended for Class I design information which will not appear in the final report (which will contain Class II info.), but must be done. Appendix A should show all calculations and repetitive charts/data, but must also be referenced from within the body of the report to "count."

Report Number Maximum size of both .doc and .pdf files

Report 1 4MB

Report 2 6MB

Report 3 8MB

Report 4 10MB

Report 5 12MB

Report 6 14MB

Report 7 16MB

Report 8 18MB

Report 9 20MB

Report 11 22MB

Report 12 25MB

Report 13 25MB

Report 14 25MB

Final Report 25MB

**1.14. Each report must meet the minimum standards of professionalism.** Unprofessional reports will be severely downgraded even if the technical contents are correct.

**1.15. Point Distributions**

1.15.1 Students Choosing to Participate in a Team Aircraft Design Competition:

Team Reports: 200

Individual Sections: 200

Peer Grade: 200

PDR, CDR & FDR 200

Final Submission Grade: 200

1.15.2 Students Choosing to Participate in an Individual Aircraft Design Competition or Project:

Reports: 600

PDR, CDR & FDR 200

Final Submission Grade: 200

Nota Bene: This can and probably will change during the semester as expectations are updated to accommodate any changes in teaching and/or evaluation modality.

**1.16. Course Grade:**  Your numerical course grade is the sum of your report scores. Your course grade will be determined from the following scale and be reported fractionally:

**Point Score:**  1000 - 900 899 - 800 799 - 700 699 - 600 < 600

**Course Grade:**  A A- B+ B B- C+ C C- D+ D D- F

• Have a second pair of eyes go over your report. Asking a classmate who is technically skilled is a good choice as they can catch many technical things. Asking someone outside of engineering to do this is also good as well as they can catch spelling, diction & grammar errors.

**1.17. Late Penalties:**

A student who submits an assignment after the due date and time must have a valid excuse (medical/emergency) to receive full credit. If no valid excuse is given, the following penalties will be applied:

Late from 0 to 10 minutes: no points deducted Late 10 minutes to 60 minutes: 1% of assignment per minute

Late from 1 hour to 24 hours: 50% Late 24 hours to the end of the semester: 100%

Note that the time stamp on the University of Kansas, Gmail and Yahoo computer systems shall count as demonstration of the day and time when submission was made. Take note that many computer and e-mail systems tend to choke at due dates and times. Accordingly, procrastination is not advisable as no allowance will be made for "slow" e-mail systems/servers/computers.



**1.18. Prerequisites:** The following courses are MANDATORY PREREQUISITES for AE 521: AE 421, AE 508, AE 545, AE 551 and AE 572. If you have not yet passed each and every one of these classes, you will be administratively disenrolled and could receive either a "W," "WF" or "F" for the AE 521.

**1.19 Virtual Meetings:** From time to time, students and Dr. B. cannot physically attend a given class meeting time. Given modern technology, this is easy to accommodate by using virtual meetings. Dr. B.'s general Zoom URL is:

<https://us06web.zoom.us/j/9584548013>

Click on the link at the given virtual meeting times as prearranged.

**Table I AE 522 Class Schedule Spring 2024**

**A screenshot of a calendar

Description automatically generated**

**Preliminary Design Review**

**To be recorded via Zoom on or before Friday 2/24**

**Time TBD**

**50 points**

Dr. B. Will then share with experts.

*Purpose:*

*Get feedback from professionals and user community at an early design stage*

Structure:

1. Title Slide with handsome faces, names & jobs
2. Mission Specification & Profile
3. Overarching Design Philosophy
4. Report Contents
5. Current State of Design
6. Coming Design Steps

• Prepare in PowerPoint format

• Audience: industry and missile design engineers and experts

• Mark every page as: "Competition Sensitive for Evaluation Purposes Only"

• If you have a proprietary idea, mark that page as such

• Every team member should speak with Team Leader going first, introducing team

• Try to give similar amounts of time for each member

• Target 30 – 45 min. If it's a bit longer, that's okay, just keep it under 1 hr

• Thank audience for taking the time to review the work and will "look forward to feedback"

**Table II Current Team Memberships & Individual Competitors**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| AIAA UGTeam Stratoforce | AIAA UG Individual | AIAA Grad. Missile | AIAA Grad. Electric Sailplane | UG Special |
| Liliana | Maggie | Jeb | Cole | Payton (coleopters) |
| Cherry | Carson | Junior 1 | Ben | Jennifer (coleopters) |
| Gracyn |  | Junior 2 | Tim | Reanne |
| Lucy |  | Junior 3 | Josh | Josh D (swarm)  Josh S (swarm) |
| Camden |  |  | Reanne | McCoy (swarm) |
| Sam |  |  |  | Jack (swarm) |
|  |  |  |  |  |

**Table III AE 522 & 722 Schedule by Day, Time & Location**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** |
| 9 | - 10AM | Swarm 9:30 - 10 | Carson 9 – 9:30 | Swarm 9:30 - 10 | Carson 9 – 9:30 | Bo 9:00 – 9:30  Shanya 9:30 - 10 |
| 10 | - 11AM | Coleopters |  | Coleopters |  |  |
| 11 | - 12PM |  |  | Maggie 11:30-12 |  | Maggie 11:30-12 |
| 12 | - 1PM | Olivia in Lab | Olivia in Lab  DBF 12:30 – 1:00 | Olivia in Lab | Olivia in Lab | Olivia in Lab |
| 1 | - 2PM | Olivia in Lab  Electric Sailplane | Olivia in Lab Stratoforce | Olivia in Lab  Electric Sailplane | Olivia in Lab Stratoforce | General G400 |
| 2 | - 3PM | Reanne | Jeb | Reanne | Jeb | General G400 |
| 3 | - 4PM | Faculty Meeting |  |  |  |  |
| 4 | - 5PM |  |  |  |  |  |

**2. Assignments and Report Sections**

**Table 2.1 AE 522 Assignments and Due Dates**

|  |
| --- |
| **Report 1**  Report Cover Page with student head shots on white backgrounds  The following are placeholders to be filled out later:  Acknowledgments  Table of Contents  List of Symbols  List of Tables  List of Figures  **Chapter 1 Introduction, General Concept of Operations, Mission Specification and Profile**  Students must make at least one high quality Concept of Operations including the overall scheme for each aircraft type/class. This will be followed by Mission Specification and Profiles. Cutting and pasting properly done work from AE 521 in the Fall is fine so long as the original author is referenced (so it's not plagiarism). There should be a nice Mission Specification in a neat table (preferably) or bulletized form. The Mission Profile should be done in CAD as was the case for AE 521. A short discussion of the drivers, direct and implied goals is always good. Note that conditions in the Fall were quite lax. Because this will be a competition document which will go to the world's finest missile designers, the standards will be incrementally higher.  Examine all of the details of the Mission Specification and Profile put forth by the AIAA.  **References** (always at end of report)  **Appendix A:**  • List Team Members' actions, roles on the team and contributions  • Recruitment of Minions  List efforts to enlist freshmen, sophomores, juniors, seniors and Grad. Students to help with the report. Remember that every hour spent on the project by a minion is one less hour you have to spend.  • All Students choosing to compete in the AIAA Design Competitions must get AIAA Membership by 30 January 2024.  • Decide on Team Leadership  -Team Leader  -Deputy Team Leader  -Report Boss  -CAD Boss  • Download and examine all relevant competitive and winning past reports  For Chapter 2, not due on 1/22: |

**Report 2**

Due 29 Jan. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters and Contents, reworked as directed as well as Appendix A**

**Chapter 2 Historical Review, Competition in the Market**

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Team**  **Stratoforce** | **UG Individual**  **Stratospheric P/L** | **Special Project**  **Coleopters** | **Special Project**  **Counterdrone Swarm** |
| **2.1 Historical Review**  Summarize all heavy lifters that are relevant to the spec. Include especially all jet-powered strategic lifters from around the world from 1960, forward, American, European, Soviet/Ukrainian. Give a short paragraph about each, a picture with background stripped and top-level information on geometry, costs, fleet sizes and performance.  **2.2 Relevant Aircraft Markets and Missions**  Describe the market for strategic airlifters. Feel free to lift verbiage from the AIAA RFP (with appropriate reference, of course) Look up articles in Av. Week and other trade publications to describe market | **2.1 Historical Review**  Summarize programs and the atmospheric chemistry and physics that are related to the spec. Of course this will be difficult as the spec. itself is weird, but do your best. Describe the aircraft that are used for this role. Give a short paragraph about each, a picture with background stripped and top-level information on geometry, costs, fleet sizes and performance.  Check out sources like:  <https://www.fargojet.com/cloud-seeding/>  <https://en.wikipedia.org/wiki/Cloud_seeding>  <https://www.wsj.com/story/cloud-seeding-takes-flight-in-western-us-76737400>  **2.2 Relevant Aircraft Markets and Missions**  Describe the possible market (which will, of course, be limited). Feel free to lift verbiage from the AIAA RFP (with appropriate reference, of course) Look up articles in Av. Week and other trade publications to describe market | **2.1 Review of Present Coleopter Designs**  Get the dimensions of all of the tools, parts and shipping containers that currently reside in the lab, 1182 Learned Hall. CAD up all of the existing tools, parts and shipping containers. Present .jpg figures of all the existing components in front, top & side views.  **2.2 Powerplant and Rotor Sizing**  Given the various components, size the powerplants and rotors for each of the designs, scaling them from the XQ-138. Report the powerplants and rotors and include URLs for each component in this section. | **2.1 Review of Present Counterdrone and Countermissile Systems**  Research and summarize each counterdrone and countermissile system that can be found. Concentrate especially on physical systems and counterdrone/countermissile aircraft. Include fixed- and rotary-wing solutions, missiles and gunnery. Get pictures of each system and include a short write up on each system with a properly referenced figure of the system.  **2.2 Relevant Aircraft Markets and Missions**  Describe the possible market(s) for such systems including Ukraine, the Middle East, Taiwan and elsewhere. Discuss geopolitical implications and potential funding. Estimate market size for such systems and work to quote politicians and decision-makers on the need for such systems. |

**Chapter 3 Design Philosophy & Configuration Constraint Establishment**

By examining the Mission Specification and associated specified requirements, develop a "Motto" and "Design Philosophy." The motto should only be a few words (5 or less typically), describing the aircraft, team and/or project. Tell the reader in (preferably) one sentence the overall direction that your design will take. Use this philosophy to guide coming decisions in addition to all of the aforementioned.

By using the listed Requirements and Objectives and Design Optimization Function, layout any and all configuration constraints. Use either a generic CAD of a hypothetical aircraft or superimpose the constraints on a representative aircraft of the class under consideration.

**Chapter 4 Objectives, Requirements and Design Optimization Function**

As was described in AE 521, list the Requirements, Objectives, Ancillary Objectives and generate an Optimization Function. Include "special" considerations like minimization of ramp footprint, ground servicing, turnaround time, favorable turbine engine-to-electric motor coupling cold turning rotor turns, noise, ride quality, flight and ground safety, certifiability, and insurance. Include especially guidance that will help with configuration layout and "special" operational considerations and/or supporting systems.

List as many flowdown requirements and objectives to the lowest Tiers possible.

**Chapter 5 STAMPED Analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| **UG Team**  **Stratoforce** | **UG Individual**  **Stratospheric P/L** | **Special Project**  **Coleopters** | **Special Project**  **Counterdrone Swarm** |
| Gather relevant geometric, weights, engine and performance data and track the data with time. Include especially weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs for all historical aircraft. | Gather relevant geometric, weights, engine and performance data and track the data with time. Include especially weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs for all historical aircraft. Of course, the data will be sparse given the oddity of the spec. | Get as much information as possible on the XQ-138 and the ST Aerospace Fantail series aircraft as well as AVID and Honeywell and others. Include especially weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs for all historical aircraft. | Get as much information as possible on existing physical counter UAS devices and countermissile systems. Make a nod to the electromagnetic and energy weapons, but concentrate on physical systems if possible. Include especially weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs for all historical aircraft. |

**References** (always at end of report)

**Appendix A:**

• List Team Members' actions, roles on the team and contributions

• Recruitment of Minions

List efforts to enlist freshmen, sophomores, juniors, seniors and Grad. Students to help with the report. Remember that every hour spent on the project by a minion is one less hour you have to spend.

• All Students choosing to compete in the AIAA Design Competitions must get AIAA Membership by 30 January 2024.

• Decide on Team Leadership

-Team Leader

-Deputy Team Leader

-Report Boss

-CAD Boss

**Report 3**

Due 5 Feb. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters and Contents, reworked as directed as well as Appendix A**

**Chapter 1 Introduction, General Concept of Operations, Mission Specification and Profile**

\*\*Chapter Refinement\*\*

Update the Conops as recommended earlier, knowing that this is a "living document" and will change with time as the report matures.

**Chapter 2 Historical Review, Competition in the Market**

Update Historical Review and Competition as directed by Dr. B. and/or if new info. has become available.

**Chapter 3 Design Philosophy & Configuration Constraint Establishment**

Design Philosophy and Configuration Constraint Establishment

By examining the Mission Specification and associated specified requirements, develop a "Motto" and "Design Philosophy." The motto should only be a few words (5 or less typically), describing the aircraft, team and/or project. Tell the reader in (preferably) one sentence the overall direction that your design will take. Use this philosophy to guide coming decisions in addition to all of the aforementioned.

By using the listed Requirements and Objectives and Design Optimization Function, layout any and all configuration constraints. Use either a generic CAD of a hypothetical aircraft or superimpose the constraints on a representative aircraft of the class under consideration.

**Chapter 4 Objectives, Requirements and Design Optimization Function**

Given new information, adjust the ancillary objectives listed in Report 2. Stretch Tier 0 Requirements to as many Tier 1 Flowdown requirements as possible. Construct and show the Tier 0 to Tier 1 Requirements and Objectives Flowdown Chart.

**Chapter 5 STAMPED Analysis** (Weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs)

\*\* Chapter Refinement\*\*

Continue STAMPED information generation. Track as many relevant variables as possible.

**Chapter 6 Candidate Configuration Matrix Establishment**

Following the examples in previous reports and the notes, generate a sweep of candidate configurations. It's perfectly acceptable to generate configurations that reflect common configurations and design practices, but that may be directly at odds with the Design Philosophy and will be almost instantly deselected once your Configuration Constraints are applied. That's okay as you'll need to explain to the reader what you've done and why. For this first configuration matrix, just cast your net wide. Keep configurations simple -- no need for aerodynamic profiles on wings -- just simple extrusions will do. Fuselages are to be kept simple, jet engines devolve to cylinders, propellers become disks etc. This is the most basic sweep of generic configurations, NOTHING FANCY! Coleopter team – you’ll do your own thing as this section is meaningless for you.

**Chapter 7 Application of Optimization Function and Requirements Flowdown Charts to Configurations and Downselection**

Using the Optimization Function and the Flowdow charts downselect the bulk of designs to just a handful of designs or one design family. For teams, downselect one to several. For individuals, downselect to one design to carry forth (you won't have the time to do several). Coleopter team – you’ll do your own thing as this section is meaningless for you.

**Chapter 8 Weight Sizing**

Note that this is a placeholder section. You will perform Class I weight sizing via the Appendix B below. Chapter 8 of the Competition Report will be devoted to Class II weight sizing, but will use Class I as a starting point. Coleopter team – you will have to properly size the powerplant assemblies for both hover and dash. We’ll go over it in our individual meetings.

References (always at end of report, before the appendices)

**Appendix A**

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Draft an aesthetics survey sheet to pass out to people and get feedback on multiple designs for commercial aircraft designs.

**Appendix B Class I Weight Sizing**

Using the methods described in class, arrive at the Class I weight sizing of the aircraft. From this sizing exercise, you should determine: Wto, We, Wf, Wpl, Wpax, Woe, Wtfo and other important weights. Determine critical numbers like L/D cruise from STAMPED information on L/Ds of advanced aircraft derived from payload-range diagrams. Critical values for BSFC and TSFC can be obtained by looking at historical trending values. Show all calculations, which should in great part be done by hand and/or with spreadsheets and/or with Matlab code.

**Report 4 Coleopters**

Due 12 Feb. 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Continue CAD, mock up cardboard components for the 12” coleopter, report progress on CAD in .pdf document along with photos of the progress.

**Report 4 AIAA Individuals, Team & Swarm**

Due 12 Feb. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters and Contents, reworked as directed as well as Appendix A**

**Chapter 1 Introduction, General Concept of Operations, Mission Specification and Profile**

\*\*Chapter Refinement\*\*

Update the Conops as recommended earlier, knowing that this is a "living document" and will change with time as the report matures.

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**Chapter 5 STAMPED Analysis** (Weights, We, Wto, Wpl, Geometries, b, S, AR, Power or Thrust, Performance, Vmax, Vcr, any and all Ranges, costs)

\*\* Chapter Refinement\*\*

Continue STAMPED information generation. Track as many relevant variables as possible.

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Note that this is a placeholder section. You will perform Class I weight sizing via the Appendix B below. Chapter 8 of the Competition Report will be devoted to Class II weight sizing, but will use Class I as a starting point. Coleopter team – you will have to properly size the powerplant assemblies for both hover and dash. We’ll go over it in our individual meetings. Refer the reader to Chapter 9 if you are claiming a “Gust Load Alleviation” weight credit by pushing your gust peaks within the maneuver lines in your V-n diagram.

**Chapter 9 V-n Diagram**

Note that this is a placeholder section. You will perform all of the calculations to establish your V-n diagrams. This chapter should include a brief introduction and presentation of your V-n maneuver and gust diagrams. If your V-n diagrams alter your weight sizing, explain which points you are calling upon to claim a weight reduction.

**Chapter 10 Wing and Powerplant Sizing**

Note that this is a placeholder section. You will perform all of the calculations to establish your wing and powerplant sizing will be included in Appendix D. This chapter should include an introduction, a description of the techniques used and variables swept through (along with range of variables and explanation describing why that range was chosen) and final design point selected.

References (always at end of report, before the appendices)

**Appendix A**

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

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**Appendix C V-n Diagram Calculations**

Using the methods described in class and Roskam, Part V, place all of the calculations related to V-n diagram construction in this appendix.

**Appendix D Wing and Powerplant Sizing Calculations**

Using the methods described in class and Roskam, Part II, place all of the calculations related to wing and powerplant sizing in this appendix.

**Report 5 Coleopters**

Due 21 Feb. 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Continue CAD, mock up cardboard components for the 12” coleopter, report progress on CAD in .pdf document along with photos of the progress.

**Report 5 AIAA Individuals, Team & Swarm**

Due 21 Feb. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters and Contents, reworked as directed as well as Appendix A**

**Chapter 1 Introduction, General Concept of Operations, Mission Specification and Profile**

\*\*Chapter Refinement\*\*

Update the Conops as recommended earlier, knowing that this is a "living document" and will change with time as the report matures.

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Following the examples in previous reports and the notes, generate a sweep of candidate configurations. It's perfectly acceptable to generate configurations that reflect common configurations and design practices, but that may be directly at odds with the Design Philosophy and will be almost instantly deselected once your Configuration Constraints are applied. That's okay as you'll need to explain to the reader what you've done and why. For this first configuration matrix, just cast your net wide. Keep configurations simple -- no need for aerodynamic profiles on wings -- just simple extrusions will do. Fuselages are to be kept simple, jet engines devolve to cylinders, propellers become disks etc. This is the most basic sweep of generic configurations, NOTHING FANCY! Coleopter team – you’ll do your own thing as this section is meaningless for you.

**Chapter 7 Application of Optimization Function and Requirements Flowdown Charts to Configurations and Downselection**

Using the Optimization Function and the Flowdow charts downselect the bulk of designs to just a handful of designs or one design family. For teams, downselect one to several. For individuals, downselect to one design to carry forth (you won't have the time to do several). Coleopter team – you’ll do your own thing as this section is meaningless for you.

**Chapter 8 Weight Sizing**

Note that this is a placeholder section. You will perform Class I weight sizing via the Appendix B below. Chapter 8 of the Competition Report will be devoted to Class II weight sizing, but will use Class I as a starting point. Coleopter team – you will have to properly size the powerplant assemblies for both hover and dash. We’ll go over it in our individual meetings. Refer the reader to Chapter 9 if you are claiming a “Gust Load Alleviation” weight credit by pushing your gust peaks within the maneuver lines in your V-n diagram.

**Chapter 9 V-n Diagram**

Note that this is a placeholder section. You will perform all of the calculations to establish your V-n diagrams. This chapter should include a brief introduction and presentation of your V-n maneuver and gust diagrams. If your V-n diagrams alter your weight sizing, explain which points you are calling upon to claim a weight reduction.

**Chapter 10 Wing and Powerplant Sizing**

Note that this is a placeholder section. You will perform all of the calculations to establish your wing and powerplant sizing will be included in Appendix D. This chapter should include an introduction, a description of the techniques used and variables swept through (along with range of variables and explanation describing why that range was chosen) and final design point selected.

**Chapter 11 Advanced Technologies and Design Concepts**

Your team (or You in the case of individual competitors) is (are) considering some advanced technologies to give your design an edge. Explain these advanced technologies to the reader:

**11.1 Heilmeier's Catechism for the Advanced Technology**

In a short table or paragraph, answer the following questions.

1. What is it called?
2. What are we trying to do?
3. How does this currently get done?
4. What limits present approaches?
5. What is new about our approach?
6. Why, at this time, can our approach succeed?
7. What difference does our approach offer?
8. What are the “mid-term” and “final exams?”
9. How much will our approach cost?

**11.2 Operational and Physical Description and Concept of Technology**

Describe how the system's primary components and how they work individually and together. This description should be a bit deeper than the Heilmeier's Catechism above and should have one or more figures to explain the concept.

**11.3 State of the Art of the Advanced Technologies**

By using the library, consulting a Research Librarian, searching the Patent Gazettes and other resources, research the state of the art of the Advanced Technologies you are considering. Be sure to catalog all references you are looking at. Also, be sure to include relevant figures (with proper references, of course). Be more generous with figures rather than less -- you can always strip them later.

**11.4 Physical or Computational Research Performed**

If you have designed and performed any physical or computational research related to your advanced technology, describe the research and report the results here.

**11.5 State of Team or Individual Intellectual Property, IP Protection and/or Patent Filing**

Describe the state of the IP and any efforts you and your team are undertaking to protect the intellectual property.

**References** (always at end of report, before the appendices)

**Appendix A**

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Draft an aesthetics survey sheet to pass out to people and get feedback on multiple designs for commercial aircraft designs.

**Appendix B Class I Weight Sizing Calculations**

Using the methods described in class, arrive at the Class I weight sizing of the aircraft. From this sizing exercise, you should determine: Wto, We, Wf, Wpl, Wpax, Woe, Wtfo and other important weights. Determine critical numbers like L/D cruise from STAMPED information on L/Ds of advanced aircraft derived from payload-range diagrams. Critical values for BSFC and TSFC can be obtained by looking at historical trending values. Show all calculations, which should in great part be done by hand and/or with spreadsheets and/or with Matlab code.

**Appendix C V-n Diagram Calculations**

Using the methods described in class and Roskam, Part V, place all of the calculations related to V-n diagram construction in this appendix.

**Appendix D Wing and Powerplant Sizing Calculations**

Using the methods described in class and Roskam, Part II, place all of the calculations related to wing and powerplant sizing in this appendix.

**Appendix E Class I Cockpit and Fuselage Layout Designs**

Following the procedures laid out in Roskam's Airplane Design, Part III, Lay out the Cockpit and Fuselage of your aircraft.

**Appendix F Class I Engine Installations**

Following the procedures laid out in Roskam's Airplane Design, Part II

Addendum:

i.) Start long-term projects for coming reports, identify person(s) responsible for each:

a.) Initiate Class I Configuration Definition (enter in AAA)

b.) Initiate Class I Performance Estimation (enter in AAA)

c.) Initiate Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

**Report 6 Coleopters**

Due 28 Feb. 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Printout all component patterns for the 12” coleopters. Mock-up entire aircraft , report progress on CAD in .pdf document along with photos of the progress.

**Report 6 AIAA Individuals, Team & Swarm**

Due 28 Feb. 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – F.**

**Appendix G Class I Wing Layout Designs**

Lay out your wing as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix H Class I High Lift Device Sizing**

Perform Class I High Lift Device Sizing as covered in Roskam's Airplane Design Part II and as shown in class. If your aircraft uses some mechanism other than flaps to generate high lift coefficients, describe those devices in greater detail and model to the best of your ability. Bear in mind that often deflected slipstream techniques can be quite effective and easy to implement.

**Appendix I Class I Empennage Design**

Lay out your empennage as covered in Roskam's Airplane Design Part II and as shown in class.

**Report 7 Coleopters**

Due 6 March 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Printout all component patterns for the 12” coleopters. Mock-up entire aircraft , report progress on CAD in .pdf document along with photos of the progress.

**Report 7 AIAA Individuals, Team & Swarm**

Due 6 March 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – F.**

**Appendix J Class I Landing Gear Layout**

Lay out your landing gear as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix K Class I Weight and Balance Analysis**

Perform your Class I weight and balance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

i.) Continue long-term projects for coming reports:

a.) Class I Configuration Definition (enter in AAA)

b.) Class I Performance Estimation (enter in AAA)

c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Preliminary Design Review (PDR)**

**To be delivered sometime on or before midnight Friday 8 March 2024**

Dr. B. Will then share with experts.

Purpose: Get feedback from professionals and user community at an early design stage

Record and send both .pptx and video files to kuaerodesign@gmail.com

Structure:

1. Title Slide with handsome faces, names & jobs
2. Mission Specification & Profile
3. Overarching Design Philosophy
4. Report Contents
5. Current State of Design
6. Coming Design Steps
7. Ask questions of experts, like: Are you aware of any other changes in aircraft design and/or configuration that can reduce personnel costs? Do you think the traveling public and/or operators could accept an aircraft configured like an AN-72 rather than a traditional 737/DC-9 configuration? While the engines are overhead and far away from the ground, do you see any other grounds operations considerations with keeping them in ground idle so as to reduce the number of start cycles and associated engine fatigue?

• Prepare in PowerPoint format

• Audience: industry and aircraft design engineers and experts

• Mark every page as: "Competition Sensitive for Evaluation Purposes Only"

• If you have a proprietary idea, mark that page as such

• Every team member should speak with Team Leader going first, introducing team

• Try to give similar amounts of time for each member

• Target 30 – 45 min. If it's a bit longer, that's okay, just keep it under 1 hr

• Thank audience for taking the time to review the work and will "look forward to feedback"

**Report 8 Coleopters**

Due 20 March 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Prepare and submit all files for flatstock cutting. Layup all fuselage, nose and tail tube stocks. Submit mold pattern .stl files for rotor guard assemblies. Submit tool designs for grid fins.

**Report 8 AIAA Individuals, Team & Swarm**

Due 20 March 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix L Class I Stability and Control Analysis**

Perform a Class I Stability and Control Analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix M Class I Drag Polar and Performance Analysis**

Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

i.) Continue long-term projects for coming reports:

a.) Class I Configuration Definition (enter in AAA)

b.) Class I Performance Estimation (enter in AAA)

c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Report 9 Coleopters**

Due 27 March 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Cut the doggone parts! Fit checks are due for all paper frames, tubes, nose cone. No more excuses!

**Report 9 AIAA Individuals, Team & Swarm**

Due 27 March 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix M Class I Drag Polar and Performance Analysis**

Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix N Analysis of Weight and Balance, Stability and Control and L/D Results and Iterations**

**Appendix O Preliminary Three-View and List of Salient Characteristics**

**Appendix P Class I Layout of Major Systems**

12.1 Landing Gear Layout

12.2 Flight Control Systems

12.3 Fuel System

12.4 Hydraulic System

12.5 Electrical System

Upcoming, not due yet:

12.6 Environmental Control System

12.7 Cockpit Instrumentation

12.8 De-Icing, Anti-Icing, Rain Removal & De-Fog

12.9 Escape System

12.10 Water and Waste Systems

12.11 Safety and Survivability

i.) Continue long-term projects for coming reports:

a.) Class I Configuration Definition (enter in AAA)

b.) Class I Performance Estimation (enter in AAA)

c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Critical Design Review (CDR)**

**To be delivered sometime on or before 8am Monday 8 April 2024**

Dr. B. Will then share with experts.

Purpose: Get feedback from professionals and user community at an early design stage

Record and send both .pptx and video files to kuaerodesign@gmail.com

Structure:

1. Title Slide with handsome faces, names & jobs
2. Mission Specification & Profile
3. Overarching Design Philosophy
4. Report Contents
5. Current State of Design
6. Coming Design Steps
7. Ask questions of experts, like: Are you aware of any other changes in aircraft design and/or configuration that can reduce personnel costs? Do you think the traveling public and/or operators could accept an aircraft configured like an AN-72 rather than a traditional 737/DC-9 configuration? While the engines are overhead and far away from the ground, do you see any other grounds operations considerations with keeping them in ground idle so as to reduce the number of start cycles and associated engine fatigue?

• Prepare in PowerPoint format

• Audience: industry and aircraft design engineers and experts

• Mark every page as: "Competition Sensitive for Evaluation Purposes Only"

• If you have a proprietary idea, mark that page as such

• Every team member should speak with Team Leader going first, introducing team

• Try to give similar amounts of time for each member

• Target 30 – 45 min. If it's a bit longer, that's okay, just keep it under 1 hr

• Thank audience for taking the time to review the work and will "look forward to feedback"

**Report 10 Coleopters**

Due 3 April 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of painted, free-standing components.

**Report 10 AIAA Individuals, Team & Swarm**

Due 3 April 2024 8am to kuaerodesign@gmail.com

**All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.**

**Appendix M Class I Drag Polar and Performance Analysis**

Perform your Class I Drag Polar and Performance analysis as covered in Roskam's Airplane Design Part II and as shown in class.

**Appendix N Analysis of Weight and Balance, Stability and Control and L/D Results and Iterations**

**Appendix O Preliminary Three-View and List of Salient Characteristics**

**Appendix P Class I Layout of Major Systems**

12.1 Landing Gear Layout

12.2 Flight Control Systems

12.3 Fuel System

12.4 Hydraulic System

12.5 Electrical System

12.6 Environmental Control System

12.7 Cockpit Instrumentation

12.8 De-Icing, Anti-Icing, Rain Removal & De-Fog

12.9 Escape System

12.10 Water and Waste Systems

12.11 Safety and Survivability

i.) Continue long-term projects for coming reports:

a.) Class I Configuration Definition (enter in AAA)

b.) Class I Performance Estimation (enter in AAA)

c.) Class I Cost Analysis (translate Roskam Part VIII equations into Word and begin analysis in AAA)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

ii.) Identify and Interview Experts

**Report 11 Coleopters**

Due 10 April 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Free standing components
2. Components assembled into an aircraft
3. Components disassembled in case

**Report 11 AIAA Individuals, Team & Swarm**

Due 10 April 2024 8am to kuaerodesign@gmail.com

All Preceding Chapters & Contents, reworked as directed as well as Appendices A – K.

All previous sections +

Chapter 12 Class II Sizing of Landing Gear­­

Addendum

Chapter Q Class I Structural Layout

Chapter Z Compliance Matrix

i.) Continue long-term projects for coming reports:

a.) Update Class II Configuration Definition with Class II Weights Information (enter in AAA)

b.) Initiate Class II Performance Estimation (enter in AAA)

c.) Initiate Class II Cost Analysis

d.) Initiate Class II Stability and Control Analysis

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 12 Coleopters**

Due 17 April 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Mocked up figures cut from foam core or Depron and assembled
2. .jpgs of all parts to be laser cut
3. Full assembly of Depron parts
4. Mock up of grid fins
5. Motor mounted in Depron frame

**Report 12 AIAA Individuals, Teams, Swarm, Missile**

Due 17 April 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 11 Class II Weight and Balance

Chapter 12 Class II Systems (as appropriate)

12.1 Flight Control Systems

12.2 Fuel System

12.3 Hydraulic System

12.4 Electrical System

12.5 Environmental Control System & Cabin Sterilization

5.1. Pressurization System

5.2. Pneumatic System

5.3. Oxygen System

5.4. Air Conditioning System

5.5. Cabin Sterilization

12.6 Cockpit Instrumentation

12.7 De-Icing

12.8 Window Rain, Fog and Frost Control

12.9 Escape Systems Ingress/Egress Systems and Compatibility

12.10 Lavatory, Galley, Water and Waste Systems

12.11 Safety and Survivability

12.12 Checked Baggage or Major Cargo Handling Systems

12.13 Cabin Baggage or Infantry Accommodations

12.14 Ground Equipment and Vehicles Compatibility

Chapter 13 Fault Tree Analysis of Flight Critical Systems

Chapter Z Compliance Matrix

i.) Continue long-term projects for coming reports:

a.) Update Class II Configuration Definition with Class II Weights Information (enter in AAA)

b.) Initiate Class II Performance Estimation (enter in AAA)

c.) Initiate Class II Cost Analysis

d.) Initiate Class II Stability and Control Analysis

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

ii.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 13 Coleopters**

Due 24 April 2024 8am to [kuaerodesign@gmail.com](mailto:kuaerodesign@gmail.com)

Refine cut parts, demonstrate fit checks, mock up first incarnation of grid fins and take pictures of

1. Mocked up figures cut from foam core or Depron and assembled
2. .jpgs of all parts to be laser cut
3. Full assembly of Depron parts
4. Mock up of grid fins
5. Motor mounted in Depron frame

**Report 13 AIAA Individuals, Teams, Swarm, Missile**

Due 24 April 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 14 Class II Stability and Control

Chapter 15 Class II Performance with Electric Motors and Energy Handling

Chapter 16: Advanced CAD 3-View, Situational Rendering & Exploded View

Chapter Z Compliance Matrix

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)

**Report 14 AIAA Individuals, Teams, Swarm, Missile**

Due 1 May 2024 8am to kuaerodesign@gmail.com

All previous sections +

Chapter 17 Manufacturing, Fielding, Logistics, Handling & Deployment

Chapter 18 Class II Cost Analysis

Chapter Z Compliance Matrix

i.) List of all team member actions and contributions. Note that some team members may be assigned a "long term" job and may not show up as contributing to this section. That's okay, but it needs to be noted.

References (always at end of report)