

UNIVERSITY OF MICHIGAN
DEPARTMENT OF NAVAL ARCHITECTURE
AND MARINE ENGINEERING

**NA 475 CAPSTONE DESIGN COURSE
WINTER 2023**

Course Objectives To give students the opportunity to practice what they learned in NA470 Ship Design course, along with the knowledge they developed in the other engineering courses in a typical design situation. The work is done in a team environment with the students forming into teams to work on a design problem of their choosing. The learning objectives for this course are:

- Conduct a concept design in response to proposed set of requirements, and assess the impact of the requirements
- Select appropriate computational tools to generate knowledge through engineering analysis
- Understand and select appropriate regulations to ensure safety and environmental suitability of the design
- Understand the development of both the knowledge model and product model during early-stage ship design
- Understand how to conduct a trade study, and the existence of other decision making techniques
- Prepare and deliver technical oral presentations for expert and lay groups
- Function as an effective team member

Student teams are encouraged to enter the various design competitions such as the Lisnyk competition

Note: This syllabus gives detailed information on course policies and each required assignment, please consult carefully and frequently throughout the year

Prerequisites: NA 470

Course Requirements:

- Students work in teams of 3 to 4. Groups of 4 are suggested, as the workload is not reduced for groups of 3.
- If students are entering a design competition that allows 5 or more members on the team, they will be allowed to have 5 members if they so desire. In some situations, 6 students may be allowed.
- Attend weekly lab sessions, and weekly small-group meetings.
- Track progress through a design notebook which will be submitted.
- Design teams formulate a set of design or owner's requirements that must be met by the final design. Part of the final grade will depend on how well the design meets the design requirements.
- Design teams shall meet with the instructor weekly for 45 minutes.
- Design teams will present a formal oral mid-term progress report.
- Design teams will prepare a professional quality design report describing the design to a knowledgeable professional audience; appendices should include all details, analyses and backup information for the design report.
- Design teams shall give a final oral presentation and defense of their design before a NA&ME Review Jury made up of faculty and members of the Advisory Board.

- There will be a public presentation the day before graduation to parents, family, friends, and other invited persons. There will be a reception for students and guests after the presentations.

Instructors:

Matthew Collette
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Pauline Khan
 305 Engineering Programs Building
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GSI:

Ashleigh Simonis
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Textbooks:

The reference texts for the course are:
 Evolving online coursepack - linked from CANVAS
 Ship Design and Construction, Vol I and II, T. Lamb (Ed.), SNAME, 2003.
 NA470 Course Pack by Michael Parsons, Fall 2006.

Grading:

The Grading for the course is as follows:

Item	Weight
Mid-term Design Notebook/ Weekly Summary Grade	10%
Mid-term Oral Presentation	10%
Design Driver Trade Study	10%
Final Oral Presentation and Jury Defense	20%
Design Report	30%
Final Design Notebook / Weekly Summary Grade	10%
Public Presentation	5%
Peer Grading on Team participation effort	5%

Notes: (1) Oral presentation grades will be combination of Tech Comm and Technical evaluations combining Dr. Collette’s and Ms. Khan’s evaluation. (2) If you fail to receive a satisfactory group peer grade, and there is evidence that you have not adequately contributed to the group’s efforts, Dr. Collette reserves the right to determine your grade for the course independently of your group’s grade. Normally such a situation will result in a failing grade.

COVID Policies for 2023: The goal for this course is to hopefully do the entire course in-person, our COVID policy will be:

- In-person attendance is expected for the design lab and individual team meeting sessions as long as you are healthy. If you feel you may have been exposed, need to quarantine or isolate, you may join these meetings virtually. There is no need to document any illness or ask for permission to move to remote participation. A universal Zoom link will be placed on the CANVAS site.
- If your team is hit by a significant outbreak, I will be flexible with deadlines for a few days. If your team cannot make the jury presentation in person, we will work out an online hybrid approach.
- If Professor Collette is unwell or in quarantine, Ashleigh will run the lab sessions and each team will meet virtually with Professor Collette.

Honor Code and Plagiarism: There are many on-line sources of information on ship design, and as new naval architects it is expected that you will rely heavily on other's prior experience to guide you during you design efforts. However, the University of Michigan Honor Code fully applies to this course, and you must properly cite and give credit for the ideas of others in you design documentation and deliverables. Direct copying of ideas, text, figures, midship sections, design drawings etc. from others without attribution and adaptation for your design will result in a failing grade of "0" given for associated component of the course, and possibly failing NA 475 altogether.

Classroom Research and ABET: Both Pauline Khan and I occasionally research how well this class is working. I plan to use this research to help me better teach ship design. As part of this work, I plan to analyze your design products for my research project. This will have absolutely no bearing on your grade. In any presentation of the results, I will not include your name or any identifying details. If I plan to quote extensively (i.e., more than one sentence or an image of your work), I will follow up with an email to check that this is acceptable to you. ABET accreditation may also take copies of your work. Please contact me if you have any questions or concerns about this research.

My Explicit Support for all Students: I am excited that you are in this class and interested in a field I have worked in for more than two decades, and one that I continue to love. It is my goal to welcome you to a supportive and challenging educational environment where with hard work you will get to practice what you have studied towards over the last three and a half years. If you are struggling with the material, or with other issues, please come by my office during office hours or anytime my door is open. NA & ME prides itself on being a small, supportive department and I invite you to take advantage of that. I am here to answer questions, please ask if you are confused.

I am fully supportive of students who need to miss class to represent the university in academic, performance, and athletic events. As soon as you know of a potential schedule conflict regarding these events and 475, please let me know. We will work out a plan to keep your academic progress on track.

The University of Michigan is committed to providing equal opportunity for participation in all programs, services, and activities. Request for accommodations by persons with disabilities may be made by contacting the Services for Students with Disabilities (SSD) Office located at G664 Haven Hall. The SSD phone number is 734-763-3000. Once your eligibility for an accommodation has been determined I should be informed electronically of your accommodation. This process does not always work flawlessly, so please check in with me on email or in-person to be sure I have received everything necessary to support your education.

The University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) at (734) 764-8312 and <https://caps.umich.edu/> during and after hours, on week-ends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service (UHS) at (734) 764-8320 and <https://www.uhs.umich.edu/mentalhealthsvcs>, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources. For a listing of other mental health resources available on and off campus, visit: <http://umich.edu/~mealth/>

Deliverables: The following pages list the deliverable, due dates, and additional information for 2021. Please consult these carefully as you plan your work.

Assignment 1: Design Notebook

*****Expanded for 2023 - Copies of your online forms (from CANVAS) must be included*****

Notebook: The design notebook is used to track the progress of the design from initial sizing through to the final design. Along with your final plans, it will be used to assess the engineering rigor behind your design. The design notebook should record:

- All group handouts assignments as given in the lab periods throughout course - team agreements, owner's requirements etc.
- All online forms (e.g. Weights I prep, etc.)
- Sources of information (e.g. engine weights, equipment weights) for the design.
- Reasons why prediction methods or regulations were selected for the design.
- Tables, sketches, and discussion of alternatives for major decisions (e.g. engine, changing number of bulkheads etc.) that are not the subject of your formal trade study. For example if the initial vessel fails damage stability requirements, this fact should be recorded and the various methods considered to fix the problem evaluated such as add more bulkheads, increase beam, or increase freeboard.
- Any sketches, scheduling, meeting minutes etc. that are important to your group.

Format: The design notebook may be kept in any format that works for your group, subject to the following two requirements, (1) Every group member can access or update the notebook and (2) twice a semester Dr. Collette can access it to grade it.

Formats used by past groups have included Word documents, OneNote, Google Docs, Wikis, paper notebooks etc. The design notebook can be written in bullet-point form, with summary figures and plots pasted directly in from Maxsurf, HECSALV, etc.

Engineering entries *must* be logically organized. Some teams prefer to format each entry as a memo, using the following header data:

Subject:

Date:

People Involved:

And then organizing the notebook sequentially. Other groups have been equally successful setting up sections or headings for major aspects of the design (e.g. initial sizing, structures, damage stability etc.) and then simply having a running commentary with each entry started by a name and date.

Typically, most groups have 30-40 pages of notes at spring break, excluding the handouts and knowledge maps, and roughly double that at the end of the course. Example notebooks are available for review.

DUE: bring to every small group meeting, submission on 2-24 and 04-18 via Canvas

Assignment 2: Trade Study

Overview: Each group should pick one important aspect of their design for a formal trade study. Examples of the trade study could be podded electric vs. direct drive propulsion, arrangement options, structural materials etc. Groups should then review the trade study lecture, and prepare a formal trade study on one aspect of their design.

Format: A short (5 page) study documenting each of the seven steps presented in the lecture is required. The trade study should end with a selection of the preferred alternative, and a discussion of the selection and sensitivity of the selection to assumed and uncertain sources of information. Lengthy calculations may be submitted in an appendix if needed, brief lists and tables are fine for the intermediate trade-study steps.

DUE: 03-10 via Canvas

Note - the trade study can be submitted well before this time. Many groups prefer to do it early in the design process. Additionally, the trade-study is a stand-alone document tied to the time it was conducted - if later design information reveals that you must choose something other than what the trade study recommended that is fine, the trade study does not have to be re-done.

Assignment 3: Mid-Term Presentations

Overview: An 20-minute oral presentation, structured as if you are a naval architecture firm briefing your client on the progress of the clients design project. Provide an overview of the owners requirements, progress to date, key design drivers, and upcoming work. This assignment has two related parts, each of which comprise 50% of the overall assignment grade.

Part I: Midterm Oral Presentation Tech. Comm Review: Please schedule one 45 minute technical communication feedback session with Pauline Khan. Arrange your meeting time by sending an email to pbkhan@umich.edu in early February. To the virtual session bring:

- A draft copy of your presentation.
- *Each* member of the group should *separately* prepare a slide to address one challenging piece of information you wish to communicate. Each person should have their own slide.
- Be ready to present the slide in your virtual meeting.
- A very brief (3-4 sentences) individual reflection about what you think that you would like to improve regrading your delivery style.

During the meeting, you will discuss slide design and effective information communication via your approaches to the common slide problem, and review the rest of the draft presentation.

Part II: Midterm Oral Presentation: A 20-minute oral presentation, structured as if you are a naval architecture firm briefing your client on the progress of the client's design project, presented to Dr. Collette, with some questions at the end. **Upload a copy of your presentation to CANVAS as well as delivering it.**

DUE: Contact Pauline Khan for meeting the week of Feb 13-17 oral presentations will take place during your small group meeting times the week Feb 20-24. Note Dr. Khan will be on medical leave in January and early February, if the week of Feb 13-17 is not possible, Dr. Collette will distribute an alternate schedule in class .

Assignment 4: Jury Presentations

Overview: An oral presentation to the advisory board members, who will act as a jury. Present your complete design, including owner's requirement, initial sizing, design iterations, trade studies, and final design. The presentation should be 35-40 minutes long, and will be followed by 10 minutes of questions

The following guide is used to help the jury evaluated your presentation:

- **Design Approach** The degree to which the group was able to identify and describe key design drivers based on owner's requirements and synthesize a vessel design to meet these requirements via engineering design.
- **Technical Approach** The degree to which the group was able to select and apply appropriate analysis techniques to their design problem and explain or present the rationale for using these techniques.
- **Ability to Respond to Questions** The degree to which the group was able to respond to audience questions with clear and intelligent engineering opinions.
- **Professionalism of Presentation** The degree to which the group prepared a professional presentation with clear slide design, engineering-quality drawings or renderings, and a strong oral delivery of the material.

DUE: Will be scheduled most likely for April 12 and 13, subject to confirmation by the AB meeting time. Upload a PDF copy of your presentation to CANVAS as well as delivering it.

Assignment 5: Final Design Report

Overview: This is broadly representative of a commercial preliminary design package. Complete calculations (including intermediate steps - Excel sheets etc.) need to be presented. Please include the following, noting that most of this will simply be calculations, with the only text required in the executive summary. All reasoning, criteria selection, etc. should be presented in the design notebook. Note that the lifecycle costing is new in 2014, owner's requirements commentary in new in 2017, and the structure requirement has also changed slightly so previous reports may no longer be representative.

Required Sections:

- One-page executive summary of the design
- Owner's requirements and one-page commentary on the requirements/suggestion for changes
- Hullform Definition – lines plan, curves of form, and sectional area curve at design waterline
- Final weight estimate, listing remaining design and through-life margins with update from structural design
- Inboard profile
- Plan view of all decks
- Outboard profile
- Structural section drawings and classification society calculations at midship section for shell plate, typical frame, typical water-tight bulkhead, decks, and typical superstructures. Updated weight estimate based on these calculations.
- Resistance and propulsion calculations
- Machinery selections for main engine, generators, and any other critical machinery selected
- Electrical load analysis table for all required conditions
- Electrical one-line diagram
- Trim, intact stability, and damaged stability calculations for full and burned-out conditions. Damage stability should be run for a subset of all possible flooding cases (8) which are likely to be most severe. For stability, focus on determining and meeting applicable regulations.
- Seakeeping assessment vs. criteria
- Maneuvering assessment and assessment
- Lifecycle cost estimate including build cost and operational cost to get a reasonable cost measure for your ship.

DUE: 04-18 on Canvas

Assignment 6: Public Presentations

Overview: As we cannot gather in person to mark the end of the year this term, the public presentation will include two virtual components:

- A 5-10 minute presentation of your design to your friends and family. This should not just be a cut-down version of the your jury presentation, but instead should communicate the key concepts of your design without extensive use of technical language. See this as an opportunity to practice presenting to non-technical communities, such as corporate boards or public bodies. This will be delivered to your family and friends in FXB's Boeing Lecture Hall
- A single-slide infographic summary of your design. If you wish, this will be published on the departmental social media feeds such as Twitter.

DUE: 04-28 Presentation, Upload Slides to CANVAS

Assignment 7: Peer Grading

Overview: Complete a peer grading form for your group peers and submit electronically or in paper to Dr. Collette. The form will be provided on CANVAS.

DUE: 04-28 on Canvas