The (maritime) education at DTU -
With a focus on ship-technical affairs

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Outline

- **Introduction**
  - The framework, research-based education
  - Challenges in the maritime engineering fields (education and research around DTU)

- **Maritime education at DTU**
  - Ship technical studies/course
  - A lot of other relevant maritime courses
  - The T-shaped candidate
  - Interactions with industry – the practical side
  - Student projects around DTU together with industry

- **The academic world of today (funding of university education and research)**
Introduction

The framework... (excerpts from DTU’s strategy 2014-2019)

- **DTU’s mission** is to *develop and create value using the natural sciences and the technical sciences to benefit society*. Hence, DTU must
  - *... interact closely with society ... [and make] fruitful partnerships with industry, the service sector, and the public sector ...*

- **Education at DTU must be research-based**; that is, courses should be relevant, up-to-date, and contain state-of-the-art elements
  ("Study programmes at DTU are research-based, analytical and innovative")

- Research – and thus education – must therefore reflect the challenges faced in the given fields...
Maritime Engineering
Challenges in design and operation of ships

- Reduced fuel consumption
- Reduced CO₂, NOₓ, SOₓ and particle emissions
- Ballast water treatment
- Safety in normal as well as during adverse conditions:
  - Stability (static as well as dynamic)
  - Collision and grounding
  - Flooding and capsizing
  - Loss of power or steering capability
  - Fire
  - Arctic operations
  - Extreme weather
- Sustainability – life cycle assessment
- Automation and condition monitoring
Maritime Engineering
Other challenges/fields...

In addition to this list, a range of (interesting) other topics:

- Renewable energy (waves, tidal, wind)
- Aquaculture
- Combined use of ocean space (mining, tourism, ...)
- ... ...
Maritime studies at DTU: B.Eng. (= diplom) and M.Sc. studies

Basic information about studies at DTU

• The word ‘naval architect’ (= ‘skibsingeniør’) is not a protected title

• DTU do not offer an engineering degree in naval architecture

• Instead, the students have the freedom to select their own ‘study lines’, or ‘specializations’

• In “our” case, this is ‘maritim teknik’ (for B.Eng.) and ‘maritime engineering’ (for M.Sc.)
B.Sc. Courses
‘Classical naval architecture’

- 41202 Principles of Naval Architecture and Offshore Engineering 1
- 41263 Principles of Naval Architecture and Offshore Engineering 2
- 41271 Ship Design
- 41270 Economic and Environmental Performance of Ships
- 41280 Maritime Engineering at Sea

Good support and involvement from industry!

The basics:
- Terminology
- Hydrostatics and stability
- Waves
- Wave loads and motions

Resistance and Propulsion:
- Resistance
- Propellers
- Engine power
- Optimization of propulsion

Ship design:
- Construction and layout
- Main dimensions
- General arrangement
- Machinery
- Components
- Safety
M.Sc. Courses
‘Classical naval architecture’

- 41216 Structural Assessment of Ships
- 41221 Ship Propulsion and Manoeuvring
- 41222 Wave Loads on Ships and Offshore Structures
- 41275 Ship Operations
- 41319 Computational Fluid Dynamics

Relevant elective courses are also available from the Coastal and Fluid Mechanics Groups, the Solid Mechanics Section, DTU Electro, DTU Wind, DTU Management (Transport), DTU Compute, ...
A lot of other relevant maritime courses

41224 – Linear wave dynamics (+ 41225 Nonlinear wave dyn.)
42884 – Green transport logistics
42885 – Maritime logistics
42887 - Advanced operations research methods for vehicle routing and distribution planning
42433 - Advanced Engineering Project, Program and Portfolio Management
42115 – Network optimization
42107 – Decision support for engineers
31310 – Linear control design 2
33221 – Topics in advanced control

25104 - An introduction to ocean science and technology
25301 - Aquatic ecosystems, their exploitation, threats and management
...

Note: Impossible to take all the listed courses!

See more here: http://kurser.dtu.dk/
The T-shaped Engineering Profile
(for the ‘classical’ naval architect)

**General engineering**: Management, operation, system identification, logistics, environment, legislation, business economy, sustainability, etc.

**Specialization**:
- Ship technology
- Ship safety
- Ship environmental impact
- Intact and damage stability
- Resistance and propulsion
- Manoeuvring
- Ship structures
- Ship technical operations
- Vessel performance
- Etc.

**Foundation (basics)**: Math, physics, (structural) mechanics, statistics, computer programming, engineering design methodology, fluid mechanics, thermodynamics, materials science etc.
B.Eng. (diplomingeniør) Mechanical Engineering, 3½ years

Directed towards industry
Featuring CDIO (“conceive, design, implement, operate”)

Contents:
• Mathematics, mechanics etc.
• General engineering
• Classical Naval Architecture:
  • Principles of Naval Architecture 1: hydrostatics, stability, waves
  • Principles of Naval Architecture 2: resistance, propeller, propulsion
• Ship Design:
  main dimensions, stability, propulsion general arrangement, weights, outfit, machinery etc.
• Internship in maritime industry
• Thesis

http://www.maritime.dtu.dk/english/education
B.Sc. and M.Sc. (civilingeniør) Mechanical Engineering, 3+2 years

Directed towards industry and research

Contents:
• Mathematics, mechanics etc.
• General engineering
• Classical Naval Architecture:
  • Principles of Naval Architecture 1: hydrostatics, stability, waves
  • Principles of Naval Architecture 2: resistance, propeller, propulsion
• Ship Design:
  main dimensions, stability, propulsion
  general arrangement, weights, outfit, machinery etc.
• Specialization:
  • Waves and wave loads
  • Ship propulsion and manoeuvring
  • Ship structural assessment
  • Ship technical operations
• Thesis
http://www.maritime.dtu.dk/english/education
Nordic Master in Maritime Engineering (NMME)
2-year master’s programme

A cooperation between five Nordic technical universities:
• Aalto University, Finland,
• Chalmers University of Technology, Sweden,
• DTU,
• Royal Institute of Technology, Sweden,
• Norwegian University of Science and Technology

Five study tracks (specializations):
• Ocean structures
• Passenger ships
• Ship design
• Ship operations
• Small craft

http://www.nor-mar-eng.org/
Maritime student projects at DTU together with industrial partners

A few specific examples from FVM (2018/2019)

- Evaluating the effect of energy efficient retrofits on fuel performance – A study based on full-scale data from in-service operating ships
- Design tool for preliminary evaluation of compliance with minimum propulsion power requirements according to IMO assessment level 2
- Sea state estimation using full-scale response data from in-service container vessels
- Ship technical and economic performance as function of hull cleaning and coating practices
- Improvement of vessel performance analysis by use of AIS-data
- Propellers for MV Dana replacement
- Evaluation of a new method for computing wave added resistance from strip theory coefficients
- Efficient evaluation of nonlinear excitation and hydrostatic forces on a barge-like wave energy device
Maritime (student) projects at DTU together with industrial partners

... and many more from other sections/departments (2018/2019)

- Autonomous Situation Awareness for Navigation (DTU Electro)
- Electrical detection of cold corrosion (DTU Mech.)
- Pilot fuel ignition (DTU Mech.)
- ShipHEART (DTU Electro)
- Amonia as fuel (DTU Chem.)
- MASSHIP (Management Engineering)
- Microplastic (DTU Aqua)
- Maritime Entrepreneurship (DTU Space)
- ShippingLab (DTU Mech., DTU Electro, Maritime DTU, ...)
- ...
- ...

In general, excellent opportunities for collaboration with industry via B.Sc. and M.Sc. thesis projects
Industrial visits

FVM organises “field trips” to industrial companies;

- these trips allow students to see ship building and production in practice

- this is an important aspect and contribution to the students’ theoretical education at DTU
Industrial visits

- Visit at the headquarters of DNV GL in Høvik (yearly event)

- One-week trip to Asia to see yards and other industrial companies, including design offices and universities (every second year)

- In addition, Nul-Kryds acts as an “interface”...
Student association “Nul-Kryds”

Intellectual events

Southern Denmark 19
11-12\textsuperscript{th} of March - Fayard, Viking, DFDS, etc.

Company night 18
“Newly educated”

Shanghai 18
Yards, design offices, engine makers

Social events

Christmas Lunch

Martha Evening
...Should be part of the curriculum

Sauna Evening
More details about our programs

See the DTU student handbook: [http://sdb.dtu.dk/](http://sdb.dtu.dk/) and look for:

Diplomingeniør (B.Eng.) in Maskinteknik, specializing in Maritim teknik

Or

M.Sc. in Engineering Design and Applied Mechanics (‘Mechanical Engineering’), study line in Maritime Engineering
Funding of research and teaching at DTU

- Today’s academic world depends and relies on external funding

- This means, **No funding → No progress...!**

- Professors are expected to
  1. do excellent teaching (in line with industry needs)
  2. make and publish relevant research
  3. write applications to ensure funding of 1. and 2.
Concluding remarks

• At DTU, we strive to provide the (Danish) maritime industry with candidates that are taught both relevant and state-of-the-art subjects related to maritime engineering

• We always welcome ideas and proposals for projects (if they are relevant and feasible)

• Engagement in applications from industry are encouraged

• Finally, an appeal for visibility...

If DTU students do not see your industry...
... your industry will not see DTU candidates!
Thank you for your attention!

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