

Forum on Problem-Based Learning in Mathematics

Problem-Based Learning at AMC in First Year Engineering

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Where is the AMC?



Maritime Engineering and Hydrodynamics

With AMC

Our four year Bachelor of Engineering (Honours) degrees are accredited by:

- Engineers Australia
- Royal Institution of Naval Architects (RINA)
- International Institute of Marine Engineering, Science and Technology (IMarEST).



The Royal Institution of
Naval Architects



ENGINEERS
AUSTRALIA



Maritime Engineering and Hydrodynamics

Undergraduate degree with AMC

Bachelor of Engineering (Honours)

Specialisations include:

- **Naval Architecture**
- **Marine and Offshore Engineering**
- **Ocean Engineering**

Four year program including:

- 2 semesters per year
- 4 units per semester



Maritime Engineering and Hydrodynamics

Undergraduate degree with AMC

Bachelor of Engineering (Honours)

Specialisations and majors include:

Naval Architecture

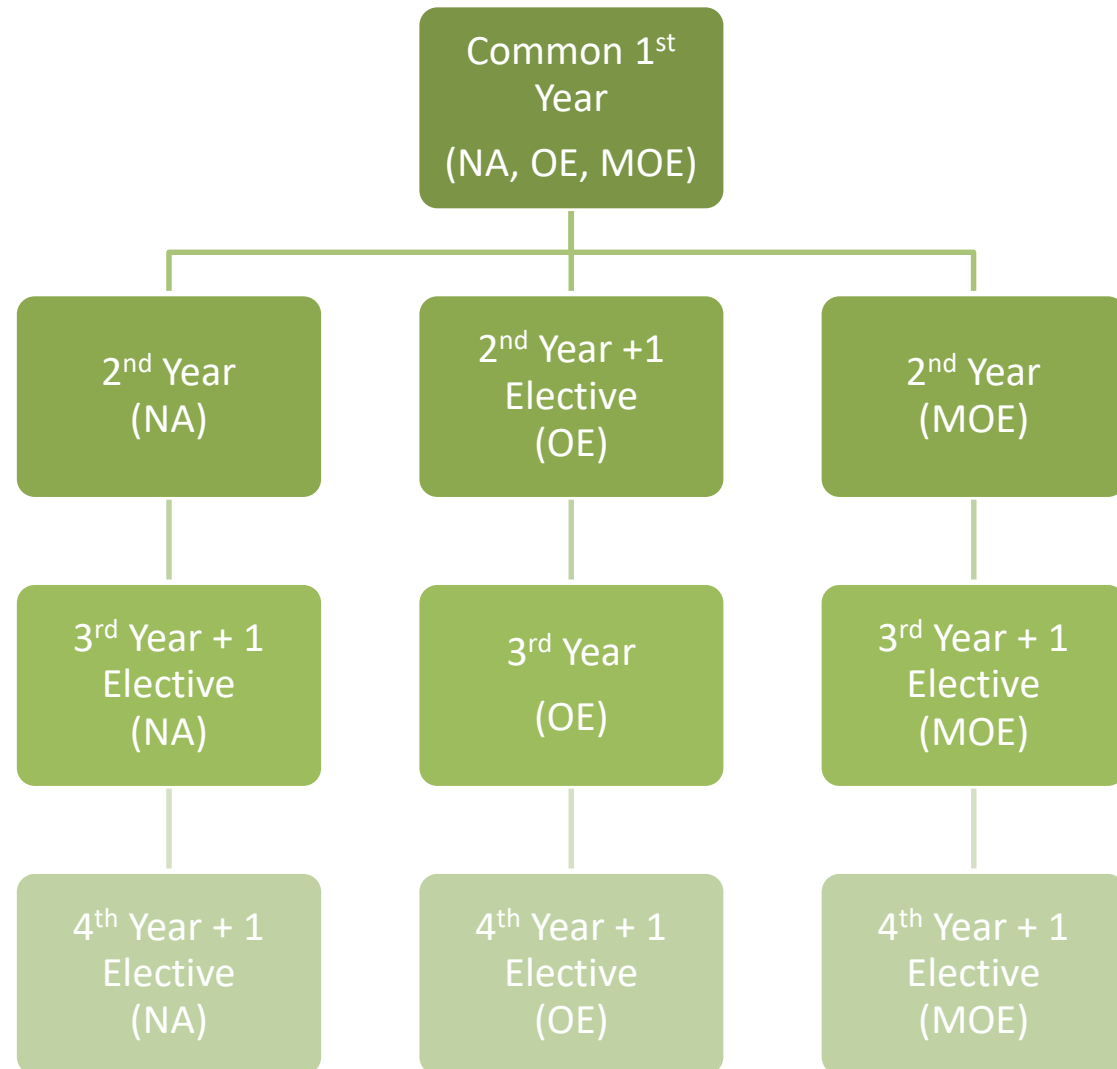
- Ship and Underwater Vehicles
- Yacht and Small Craft

Marine and Offshore Engineering

- Offshore Systems
- Marine Systems

Ocean Engineering

- Ocean and Subsea Structures



Cavitation Laboratory

- Unique in Australia and one of a handful in the world
- Specialised in cavitation (bubble) processes



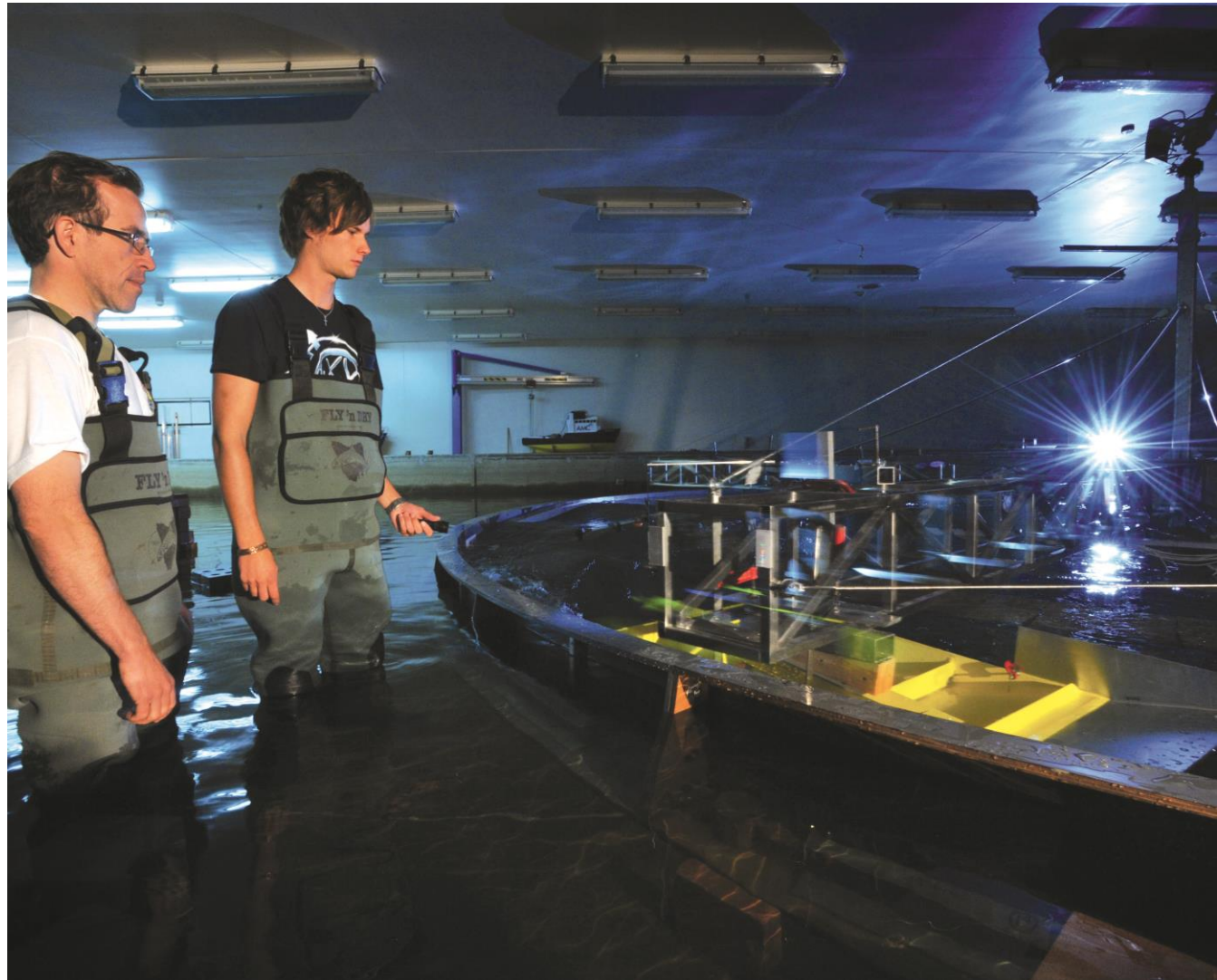
Towing Tank

- Leading hull design facility.
- Australia's largest towing tank.
- 100m long and can tow structures up to 4.6 metres per second.
- Used to measure resistance of objects in moving water including; ship hulls, submarines, offshore oil rigs and submarines.



Model Test Basin

- 35 metre long
- Wave-maker with 16 computer-controlled paddles
- Maritime operations in shallow water environments (ports, harbours, rivers and coastal regions)



Autonomous Underwater Vehicle Laboratory

- Leader in underwater robotic technologies
- Oceanographic surveys
- hydrodynamic testing and development
- remote locations such as under-ice Antarctic



And more!

The Fleet



Maritime Engineering and Hydrodynamics

First year units

Year 1	Semester 1	Credit Pts
JEE103	Mathematics I	12.50
JEE113	Engineering Design and Communication	12.50
JEE101	Programming and Problem Solving for Engineers	12.50
JEE135	Statics	12.50

	Semester 2	
JEE104	Mathematics II	12.50
JEE125	Materials Technology	12.50
JEE136	Dynamics	12.50
JEE114	Electrical Fundamentals	12.50
	Year 1 Total	100.00

PBL 1st year: The Why?

- Hands-on activities rather than bland lecturing and tutorials
- Learn by doing
- Thinking before doing
- Problem Solving Skills
- No “model” answer – think outside the box
- Motivates them to do self-directed learning (research skills)
- Project Management Skills in small group
- Closer to realistic Engineering projects - *That is what Industry want!*
- Apply first year theoretical concepts to real world engineering

The How?

- Design a project that addresses the ILOs
- Design a project that can be achieved in a semester
- Contributes XX% of the total assessment
- Provide materials
- Work and work and work on it
- Improve each year

Robotics Project



JEE101 Programming And Problem Solving For Engineers

- Solving maritime engineering problems using MATLAB and other programming languages
- Solution algorithms
- Experimental data processing
- Presentation, analysis, report writing, oral presentation and group work

JEE113 Engineering Design And Communications

- Engineering design
- Graphical communication
- Manual sketching
- Computer-aided drafting
- Problem formulation
- Connectional design solutions
- Basic CAD skills
- Oral and written skills.



PBL related ILOs: all
JEE101: 35%
JEE113: 40%



Robotics Project



- Overall aim is to develop an autonomous surface vessel to pass through a set of markers
- JEE101: Development of the robotic
- JEE113: Project management and design of the vessel
- Group of 4-5 students
- Each group is given a robotic kit
- Robotic Competition in the Model Test Basin
- Project management plan, oral presentation and report
- Peer Assessed

Robotics Project Video

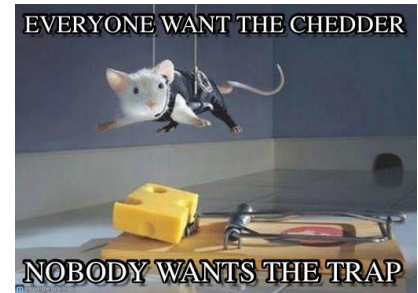


UNIVERSITY of
TASMANIA

AMC
Australian Maritime College

FYi
Maths





Rat Trap Boat (RTB) Project

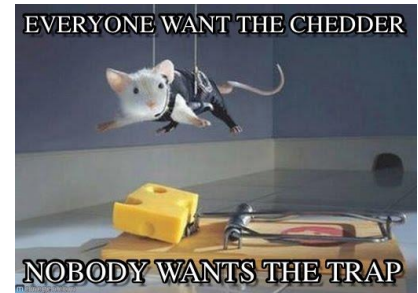
Unit JEE136 Dynamics

- Various machine motions, force and torque effects
- Kinematics and kinetics of rotating and translating rigid members, and the mechanical transmission of power

PBL related ILO

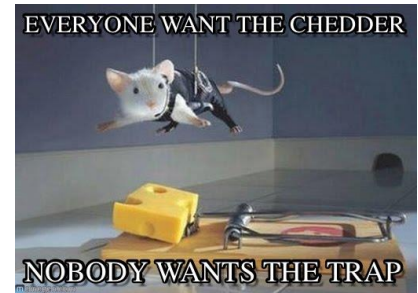
- Apply dynamic analysis, problem solving and teamwork skills in the design, construction and testing of an engineering quality product by working safely and ethically as part of a multicultural and multi-gender team and report the process, findings and outcomes to a professional standard in oral and written form

Mark: 25%



Rat Trap Boat (RTB) Project

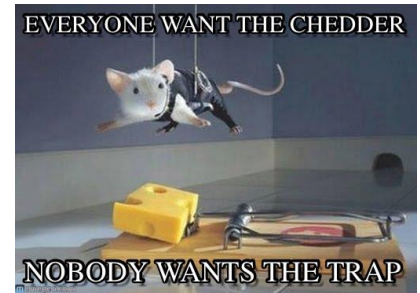
- Students are required to work in teams (4-5) to design, construct and race a boat solely powered by a rat trap (10 metres)
- Designed and constructed using sound engineering reasoning, supported by the theory learned in class, empirical knowledge gained by experiments tests as well as extensive team research



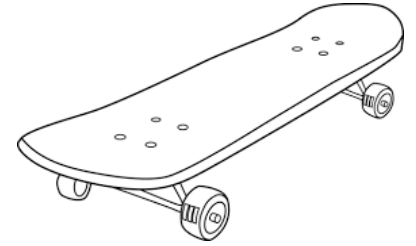
Rat Trap Boat (RTB) Project

- Video to explain the project
- Competition rules & Design specifications
- Oral team presentation
- Technical report
 - Qualitative assessment of motion
 - Calculations
 - Design and Construction Process
- Race Day
- 2016 (23.6 s); 2015 (24 s); 2014 (28.41 s); 2013 (20.75 s); 2012 (23.53 s); 2011 (18.4 s); 2010 (10.38 s); 2009 (18.12 s)
- Students can find their own sponsors
- Prize Sponsored by RINA (The Royal Institution of Naval Architects)

RTB Video



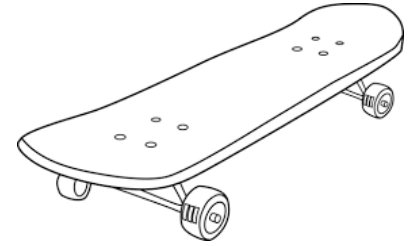
Skateboard Project



JEE125 Materials Technology

- Science of materials and their diverse role in engineering applications.
- Theoretical and practical survey of ferrous metals, polymers and composites.
- Link between structure, processing and properties.
- Case histories of material performance in practice, and the analysis of the causes of failure.

Skateboard Project

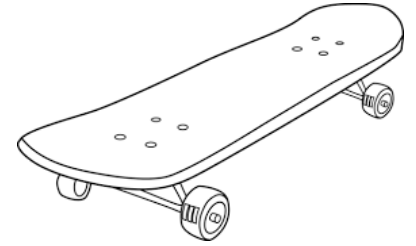


PBL related ILOs

- 1. Demonstrate the ability to conceptualize, analyse and solve engineering mechanics problems in the dynamic context by applying suitable engineering analysis theory and methods and present their work to a professional standard.
- 2. Perform experiments to quantify the dynamic characteristics and response of simple objects working individually and as a team in a safe manner and report their outcomes to a professional standard in written form.
- 4. Apply dynamic analysis, problem solving and teamwork skills in the design, construction and testing of an engineering quality product by working safely and ethically as part of a multicultural and multi-gender team and report the process, findings and outcomes to a professional standard in oral and written form.

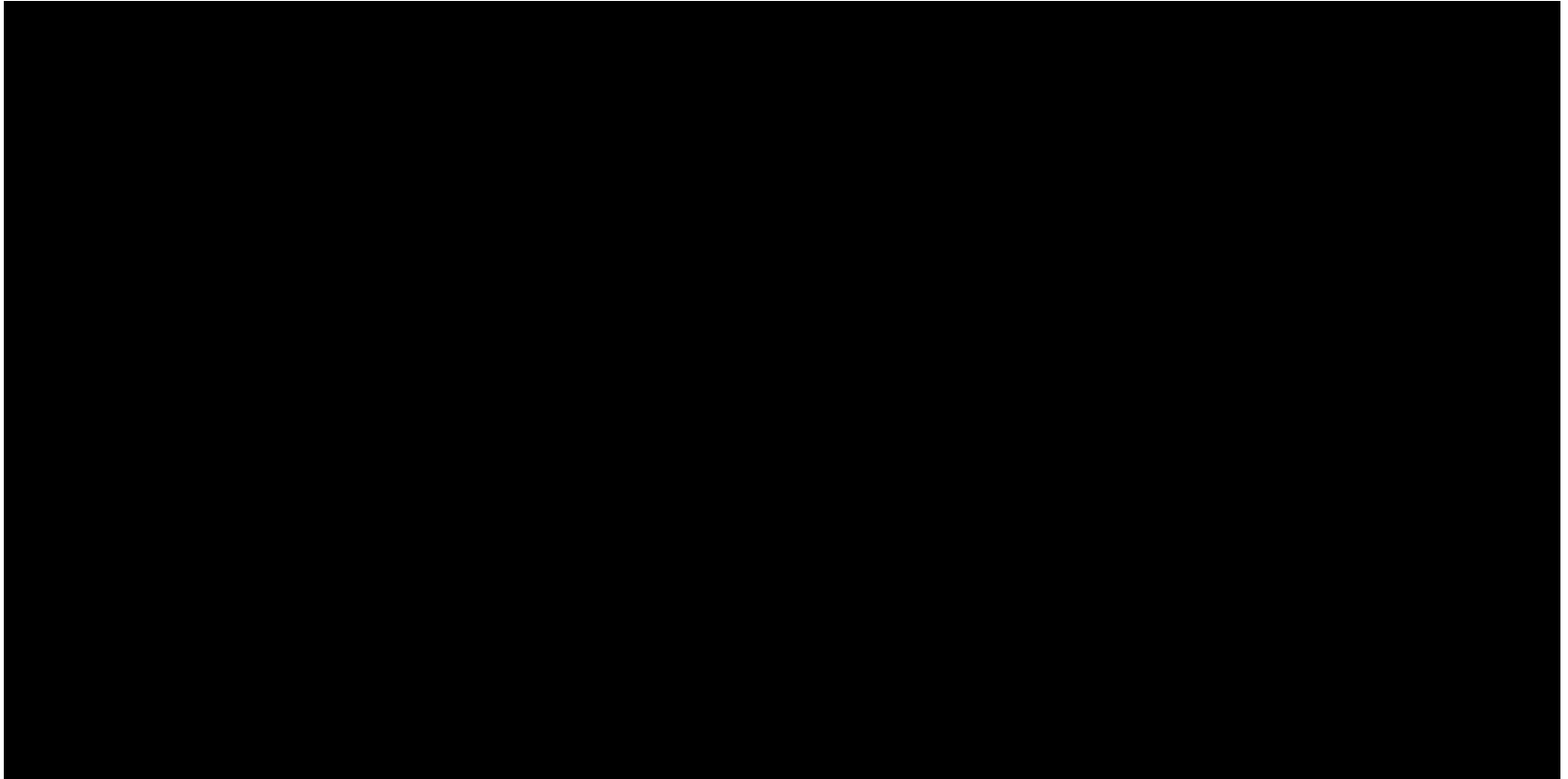
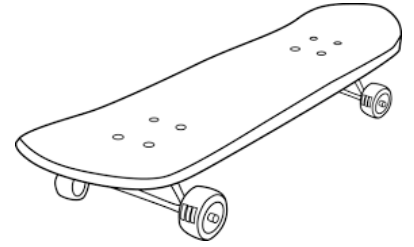
Mark: 20%

Skateboard Project

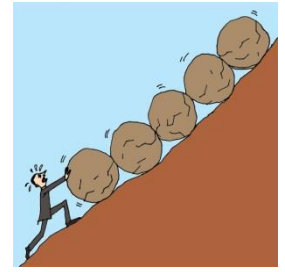


- Street performance testing of the Skateboard Design Project
- Design a composite deck after researching current best practice
- Featured a wooden core sandwiched between fibre reinforced epoxy resin cladding
- Assessed for strength and flexural properties before undergoing the final test.

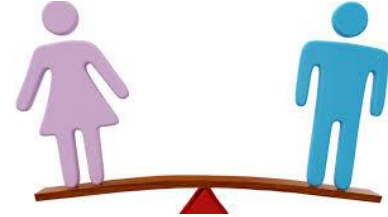
Skateboard Video



Challenges



- Non-responsive students who put in minimal effort in the group work.
 - Consider including a project plan from students with each student contribution towards the selection criteria
 - Use peer assessment: the members in a group give each other a mark which is taken into consideration in the overall mark for the project
- Needs good tutors and technical support
- Lecturer's valuable time and effort to make this possible!



Feedback from students

- Linked key concepts from theory to reality
- Being able to see exactly how things work rather than have to visualize everything
- Being able to put your own ideas into a design
- Hands on practical work seeing first-hand the theory taught
- Encouraged to be involved, practical application of study – not just theoretical maths!



Observations

- These **hands-on** projects provide a platform for students to **apply** their knowledge and skills to solve **practical** problems.
- They are also good **team** building and project **management** exercises and the students must ensure their work meets strict guidelines.
- They can be as **fun and rewarding** for the **lecturer** as they are for the students



Recipe

- There are no one way to do it
- One or more units involved in one PBL
- One or multiple ILOs
- Use available resources and build on knowledge previously learned
- You don't have to be an expert
- There always is a **second time!**

Thank you! 😊

