DEPARTMENT OF :

MECHANICAL AND AERONAUTICAL ENGINEERING

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Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Make today matter

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EBIT Open Day
20 April 2024

MECHANICAL AND AERONAUTICAL ENGINEERING

Overview: Mechanical Engineering

1. Who are we?
2. What can you study with us?
3. What is mechanical engineering?
4. Is the degree “future proof”?
5. What does the curriculum look like?
6. What facilities do we have?
7. Requirements?

MECHANICAL AND AERONAUTICAL ENGINEERING

Mechanical Engineering at UP

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- Located on the Hatfield Campus
- Largest mechanical engineering programme in South Africa
  (Approximately 1400 students)
- Maintains high standards and international recognition.
- Bachelors degree accredited by Engineering Council of SA. Degree recognised under the Washington Accord
  Recognised in 23 countries such as UK, Ireland, Canada, USA, New Zealand, Australia, and Hong Kong, Japan, China, etc.

MECHANICAL AND AERONAUTICAL ENGINEERING

Our Programmes

Degrees offered:

Bachelor degree (undergraduate)

- BEng Mechanical Engineering

Honours degrees (postgraduate)

- BEngHons Mechanical Engineering
- BScHons Applied Science Mechanics
- BScHons Applied Science Mechanics: Physical Asset Management

Research degrees (postgraduate)

- MEng
- PhD

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What is Mechanical Engineering?

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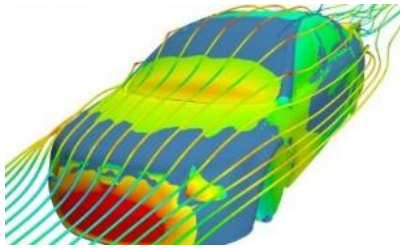
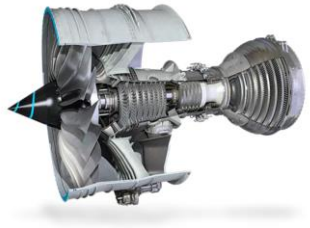
The application of mathematics and science (physics) to design, develop, manufacture and maintain mechanical equipment and systems.

It is part of the **backbone of an industrialised society:** from factories, transport, power generation, clinical equipment, mining, construction, space exploration and beyond..

Examples of mechanical equipment:


…?

Disciplines in Mechanical Engineering

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What is a mechanical system?

Mechanical equipment / component typically rely on one or more of these disciplines:

- Structural mechanics
- Thermodynamics and heat transfer
- Fluid mechanics
- Dynamics and control
- Design

Structural Mechanics

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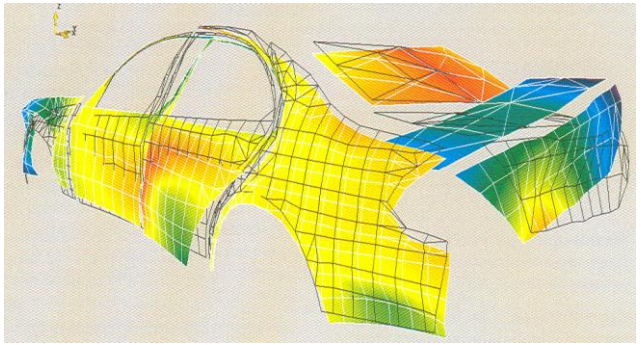
Structural mechanics deals with the analysis of the **influence of forces** on structures and includes the deformation and failure of mechanical structures.

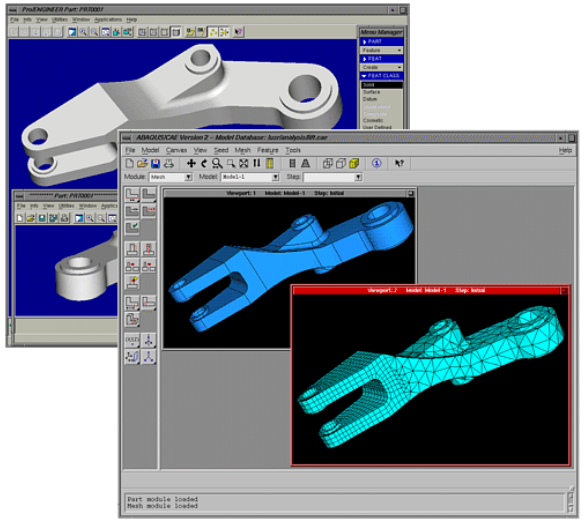
- Dynamics
- Statics

Linear and non-linear finite element methods (FEM) is used for solving problems.

Deformation modelling



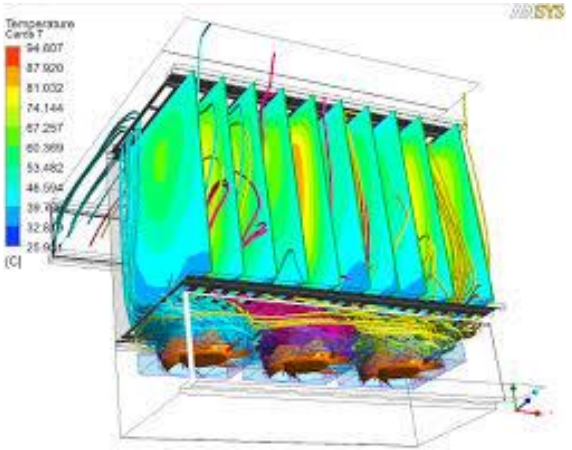
Component representation



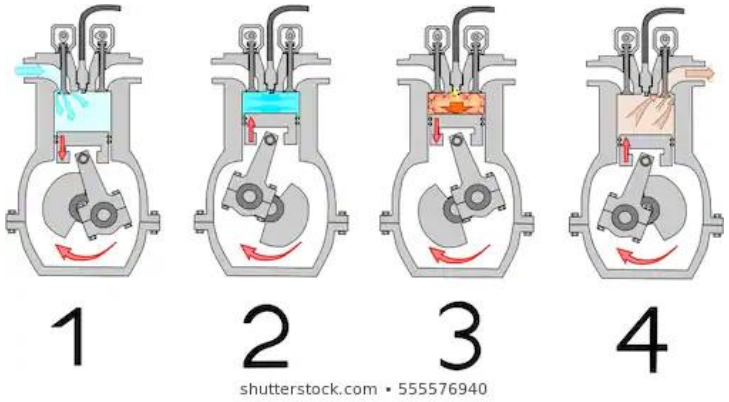
Thermodynamics and Heat Transfer

Thermodynamics is the study of **energy, heat and work**. It also deals with the conversion of energy from one form (e.g. thermal) to another (e.g. heat, steam, motion, electricity).

Electronics cooling



Heat engines

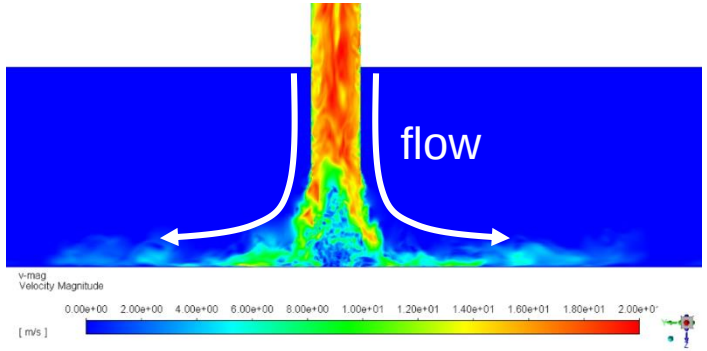


Industrial heat exchanger

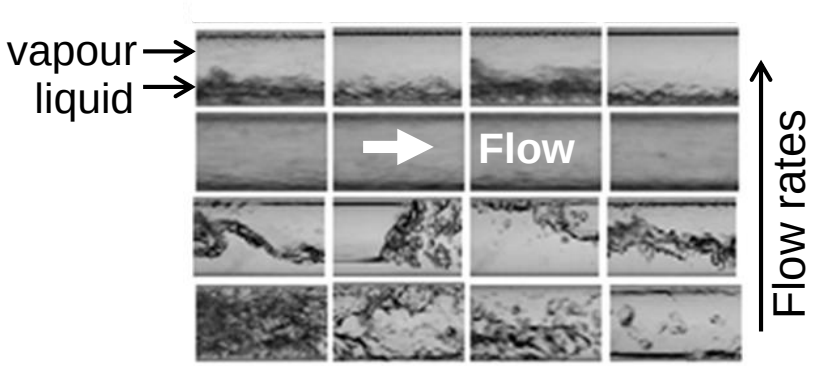
Fluid Mechanics

- Fluid mechanics: **behaviour of fluids** of engineering interest.
- **Examples:** Aircraft wings, vehicle aerodynamics, engine flow (air intake and exhaust), ventilation, pipe flows, wind loads etc.

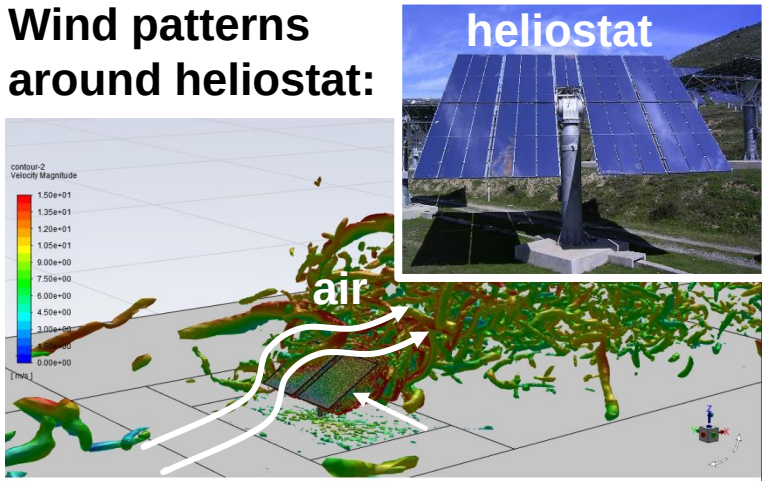
Jet impingement– enhanced heat transfer in solar tower receiver:



Refrigerant condensing:



Wind patterns around heliostat:



Dynamics and Control

Dynamics deals with the **motion of systems / structures** under the influence of loads/forces.

Control algorithms employed to get a system response in accordance with what is desired.

Student activity (example)

M5Stack self-balancing robot

video

YouTube channel: electricidea

UP project

video

Applications…

Dynamic road-load

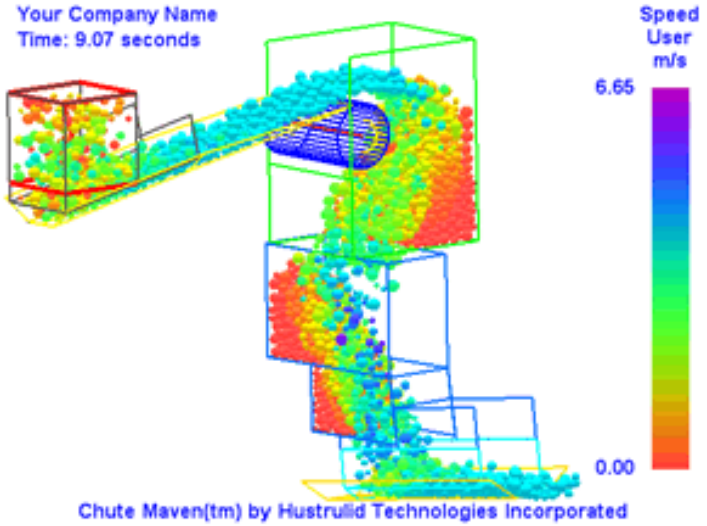
Etc..

Design

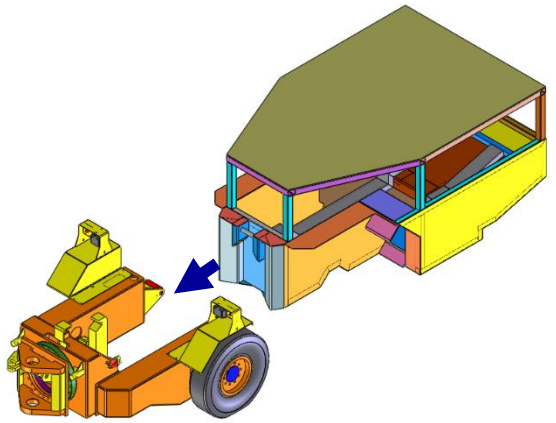
Integration of all disciplines of engineering in order to come up with a product, or a machine, or a system.

Examples from the mining industry:

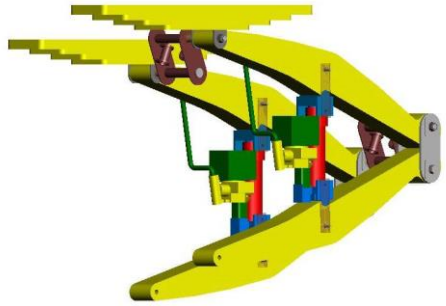
Chute and conveyor:



Transport cassette:



Underground roof support:



Mechatronics

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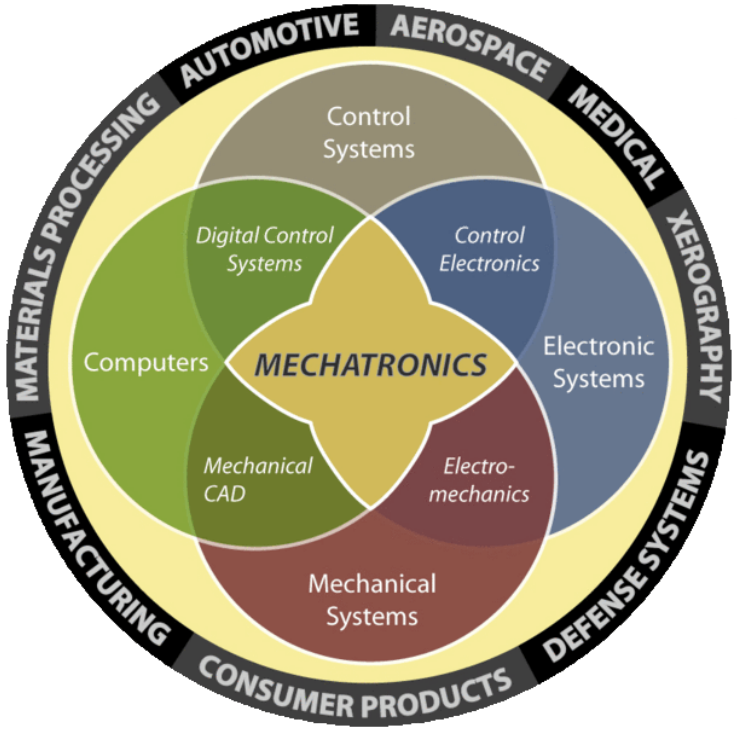
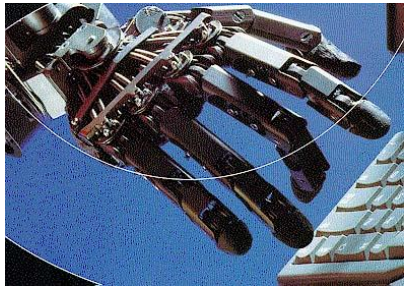
Mechatronics is the combination of **mechanical engineering**, **electronic engineering**, **computer engineering**, **control engineering**, and systems design engineering in order to design, and manufacture useful products.

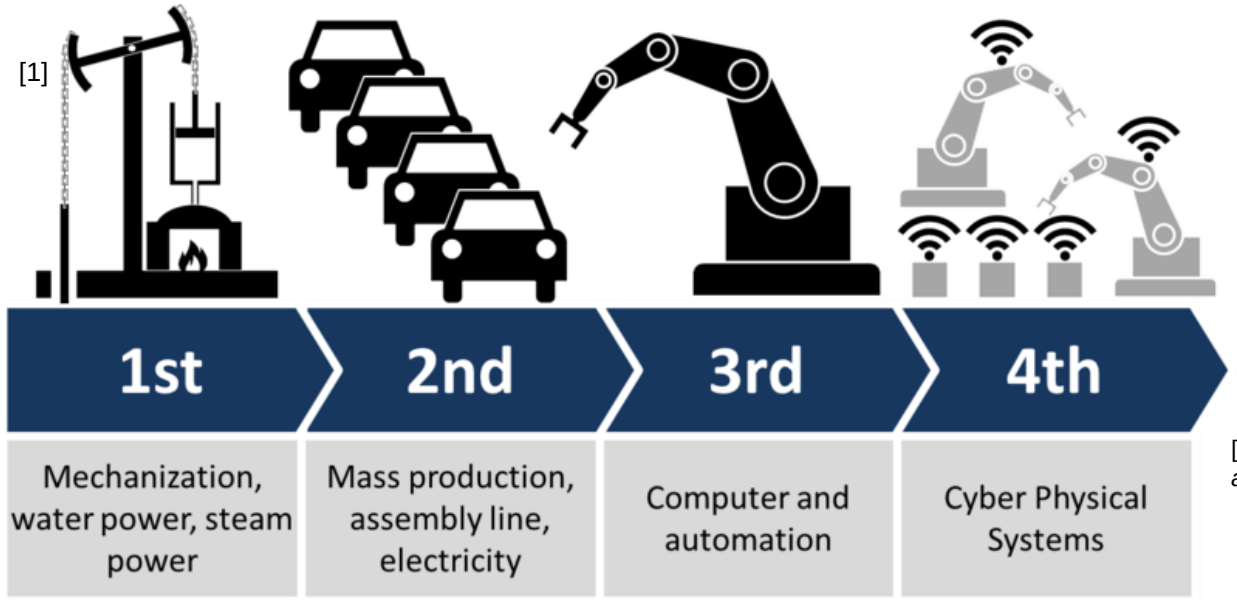


- High technology manufacturing using robotics
- Mining using robotics



Industry 4.0: The Future

[1]



[1] *Christoph Roser at AllAboutLean.com*

- Includes a combination of **autonomous robots, big data, the cloud** and **additive manufacturing**.
- Benefits: **increased knowledge sharing** among machines, production **efficiency improvements**, **production flexibility** and **reduced costs**.
- Examples: Driverless cars and metal 3D printing for manufacturing etc…

Curriculum: B.Eng (Mech)

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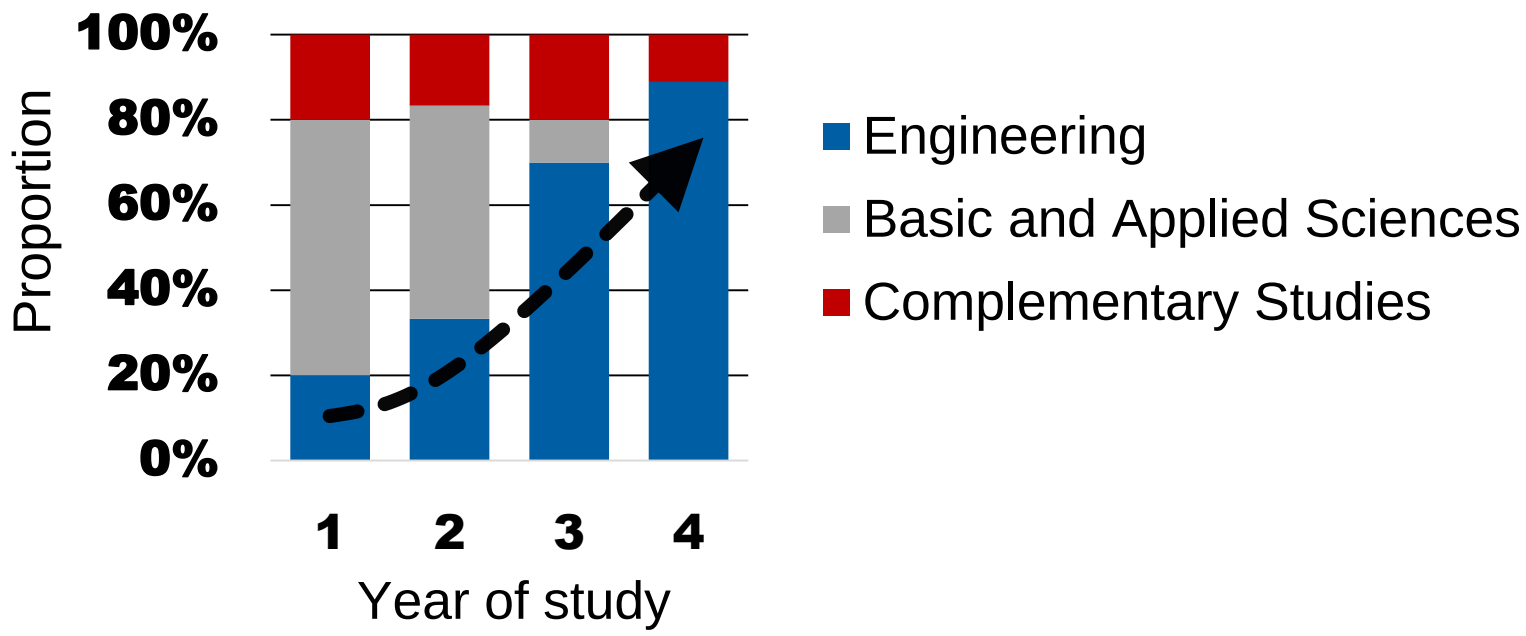
- 4-year program (Engage program: 5 years, add. modules)
- 144 credits per year (1 credit = 10 notional hours)

  (About 40 to 50 hours per week)

Composition of credits per year of study:



Final Year

- 2 Capstone projects:
  - Design project (16 credits)
  - Research project (40 credits)
- 5 Compulsory modules **including mechatronics**
- 1 Elective module (start of specialisation):

Electives: 2024

- Aeronautics
- Vehicle dynamics
- Heat and mass transfer
- Nuclear engineering
- Maintenance engineering
- Optimum design

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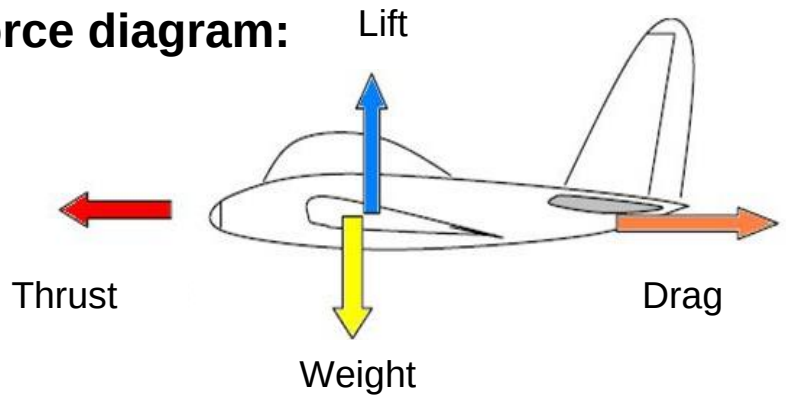
Aeronautics (elective example)

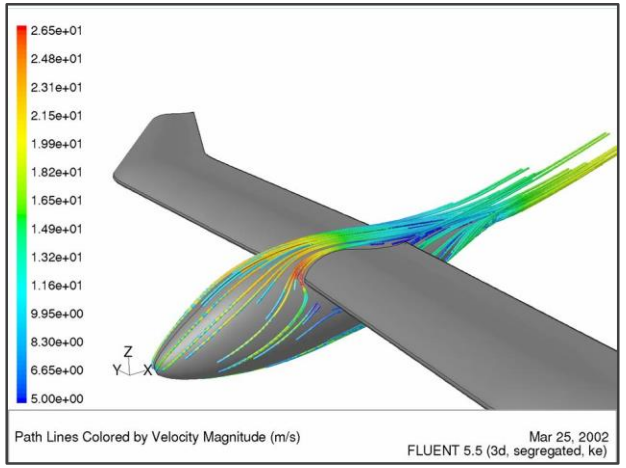
An aeronautical engineer deals with aircraft design and manufacturing, and related aeronautical products and systems.

- Aerodynamic forces
- Aircraft configuration
- Stability
- Performance

Force diagram:



Computer modelling:



Development of glider:

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Vehicle Dynamics (elective example)

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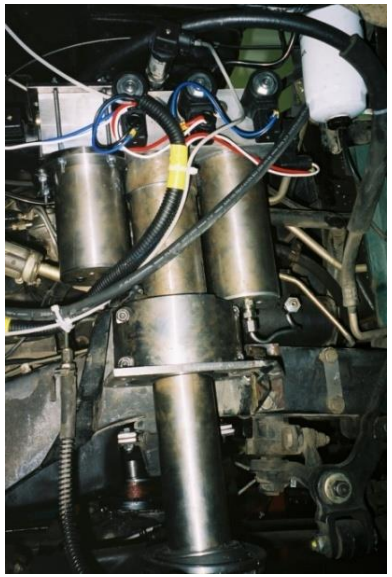
In automotive engineering, basic mechanical engineering principles are applied to design in order to improve cars, trucks, motorcycles, scooters.

- combustion,
- power-train,
- chassis
- control

Tuks Baja off-road vehicle design competition:

Computerised hydro-pneumatic suspension system:



Tyre testing and modelling:

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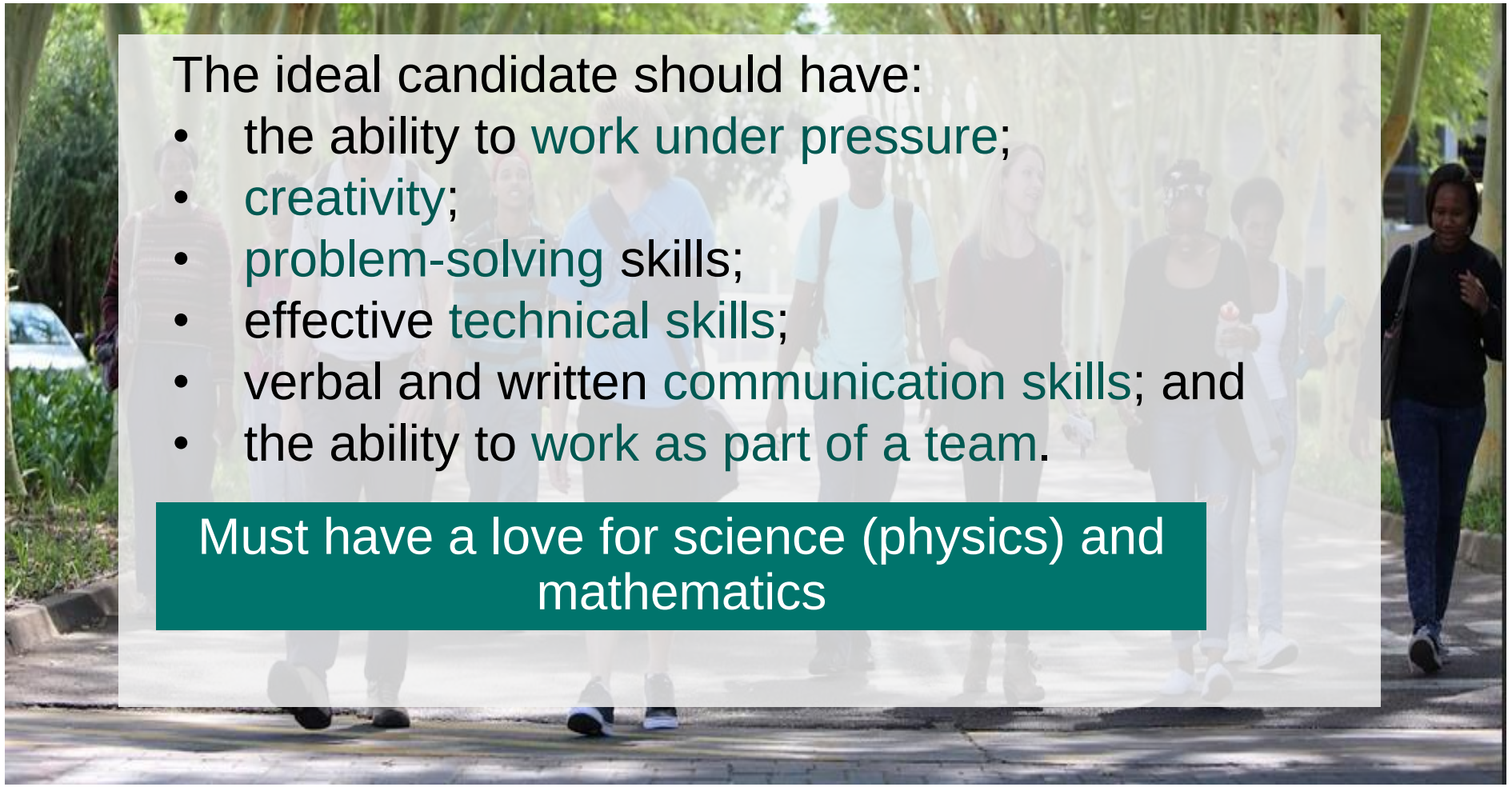
Who are the Ideal Candidates?



The ideal candidate should have:

- the ability to work under pressure;
- creativity;
- problem-solving skills;
- effective technical skills;
- verbal and written communication skills; and
- the ability to work as part of a team.

Must have a love for science (physics) and mathematics

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Employment opportunities

Many options

- **Almost all sectors of economy**
  Chemical, Mining, Manufacturing, Process, Vehicle/aircraft manufacturing, Defence, Aeronautics industry, Corporate…
- **Private Industry**
  Amplats, BMW, Panasonic, Aerosud, Boeing SA, Toyota, SAFAIR, Bosch, Kumba, Mittal, Columbus Stainless, IST, Carrier, Siemens, GEA Air-cooled Systems, Bell Equipment, BHP Billiton, Anglo-Platinum, Ansys, Oracle, Vodacom, Steinmuller, AMT Composites, Sasol, etc.
- **Semi Government Services and Corporations**
  Denel, Eskom, Randwater, SAAF, Telkom, NECSA, etc.
- **Consulting Engineers**
  LTA, DRA, MMS Technologies, Hatch Africa, Babcock, IST, Zutari, etc.
- **Tertiary Education / Research**
  University of Pretoria, CSIR, etc.
- **Own Business** (Entrepreneur)
- **Financial Sector** (Mathematical modelling of financial processes / risks)

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Virtual Tour of Our Lab Facilities

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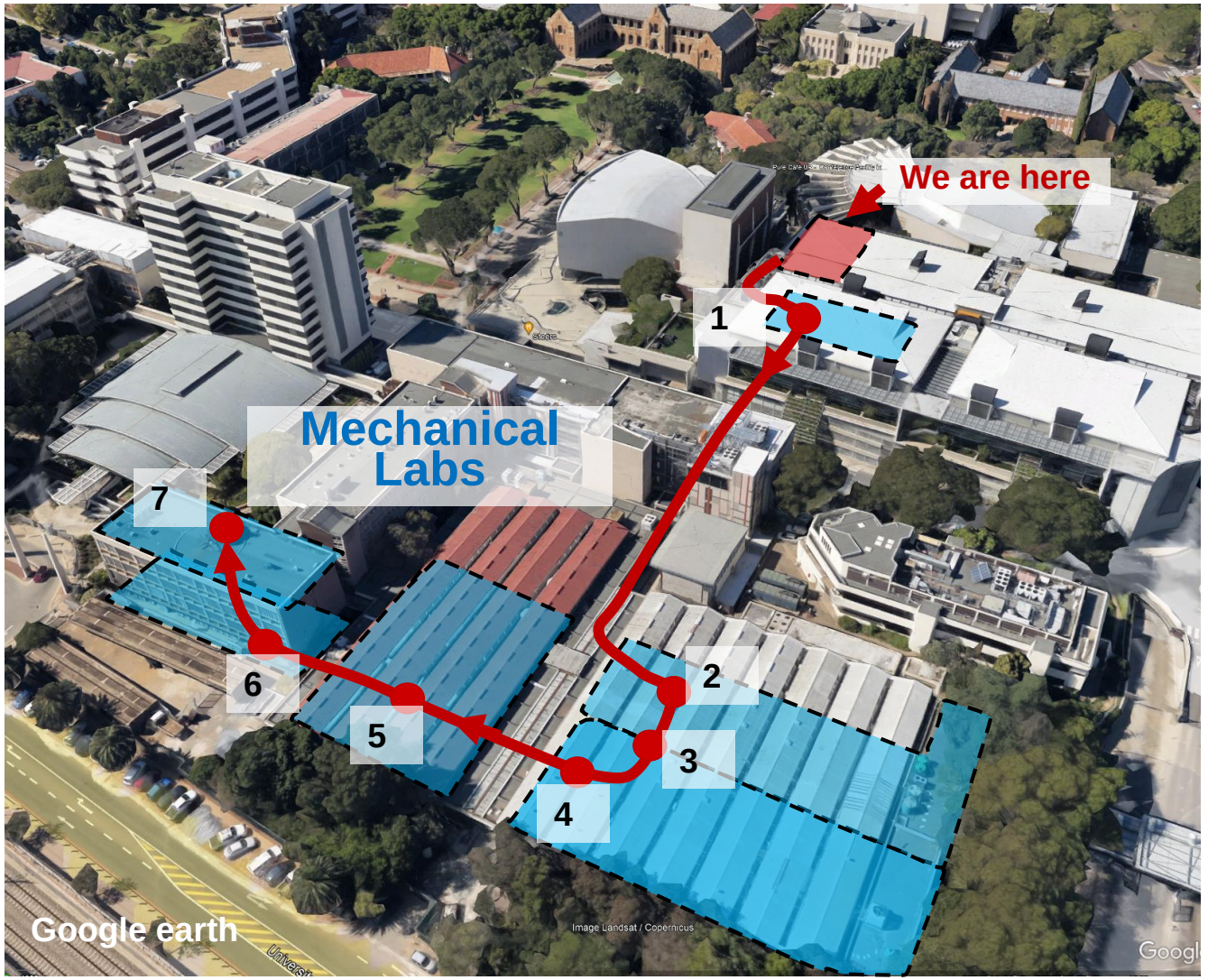
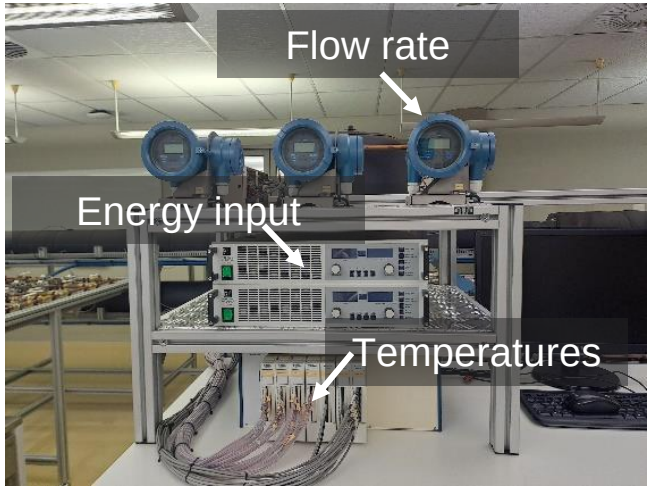


Area 1: Heat Transfer Labs (upstairs)

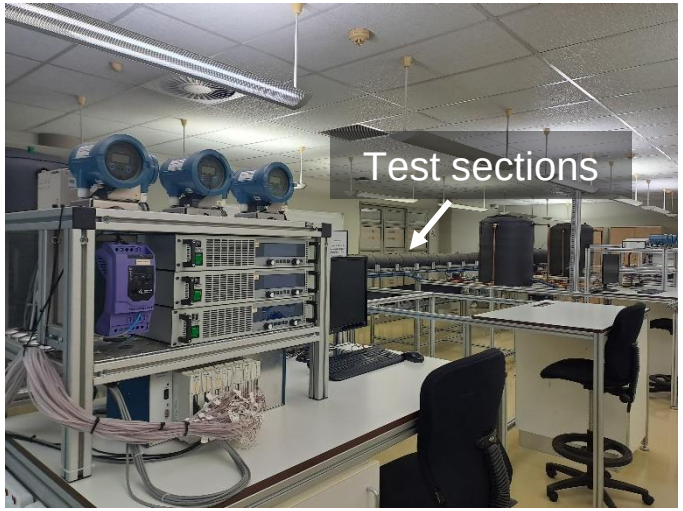
Thermal wet lab: water as testing fluid (heat exchangers)

Test benches

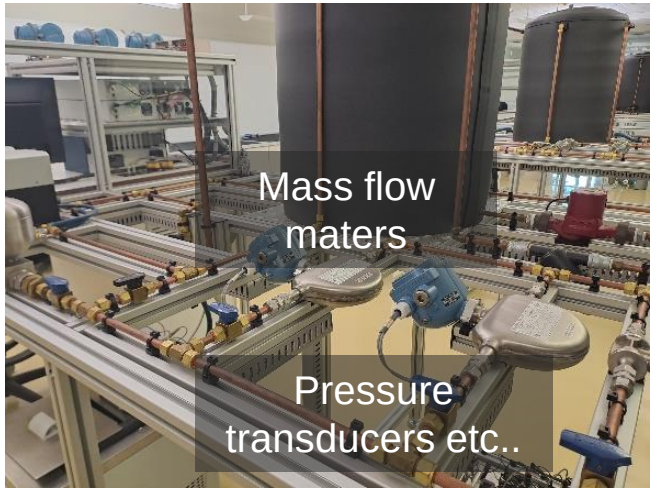
Computerised data acquisition:



Test benches



Flow path with instrumentation:



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Area 2: Clean Energy Research Labs

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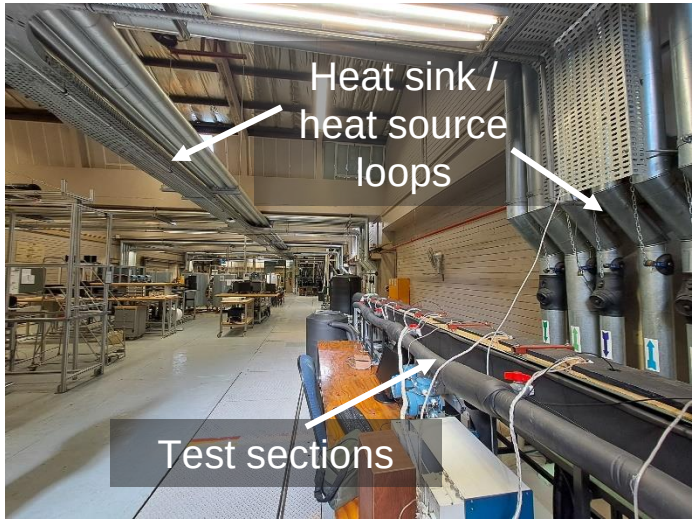
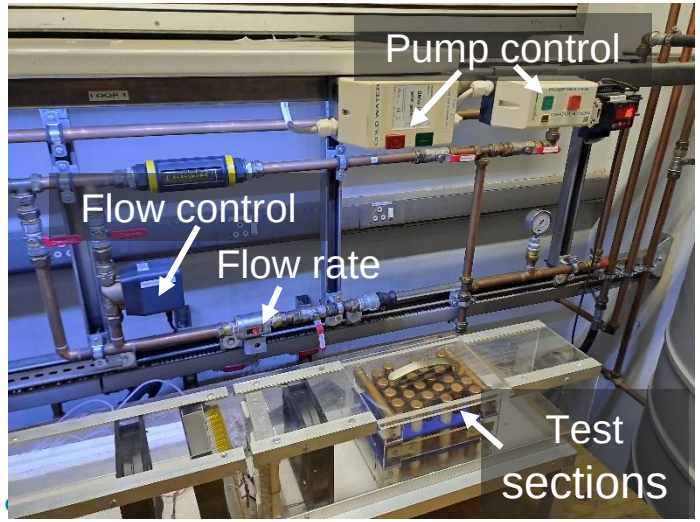
Thermal Wet lab: Water, glycol and refrigerants as testing fluid

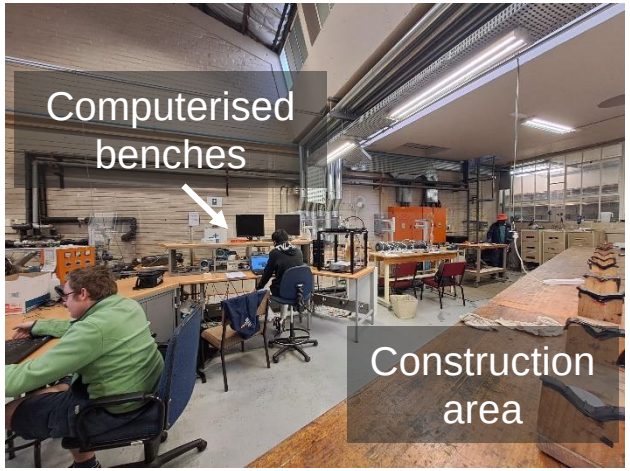
Large scale flow loops



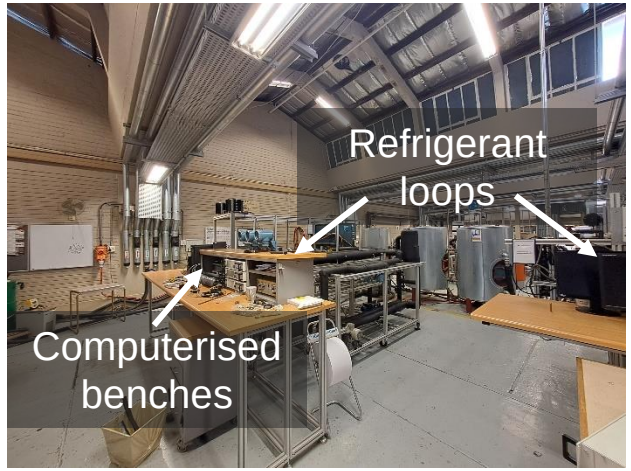
Small scale flow loops



Single phase: water / glycol



Two phase: boiling/ condensation



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Area 3: Mechanical Workshops

Manufacturing facility

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Drill presses

Lathes

CNC

Laser cutting

Sheet metals

Etc…

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Area 4: Sasol Labs

Centre for physical asset integrity management:

Electrodynamic shaker

Rotary machines

Model analysis

Endurance testing

Sag mill

Digital image correlation

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Area 5: Wind Tunnel Labs

Aerodynamics, thermal and fluid process: Air and others

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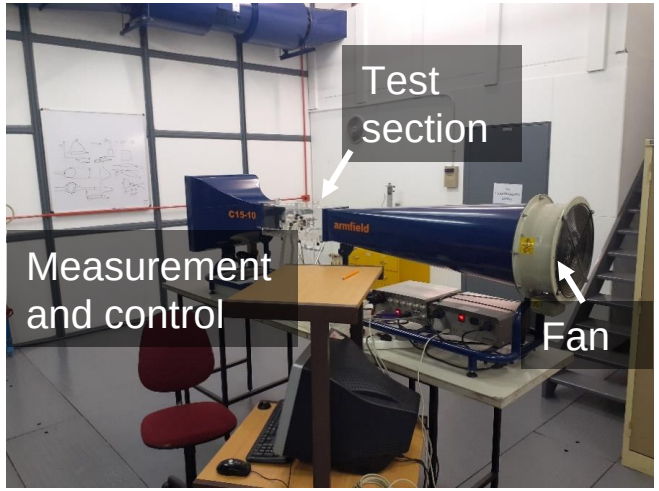
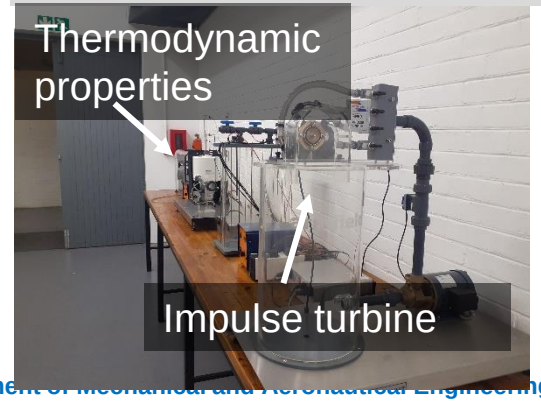
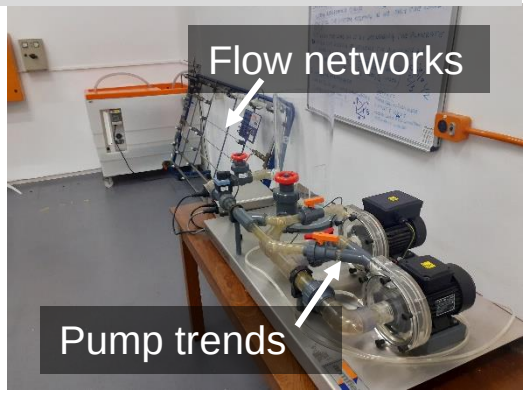
Circulating wind tunnel:

Single pass wind tunnel practical:



Undergraduate practical set up examples (etc..):





Engineered fluids facility

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Area 6: Vehicle Dynamics Labs

Mechatronics, Baja, Stability, Driver comfort, Tyres etc.

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Baja lab

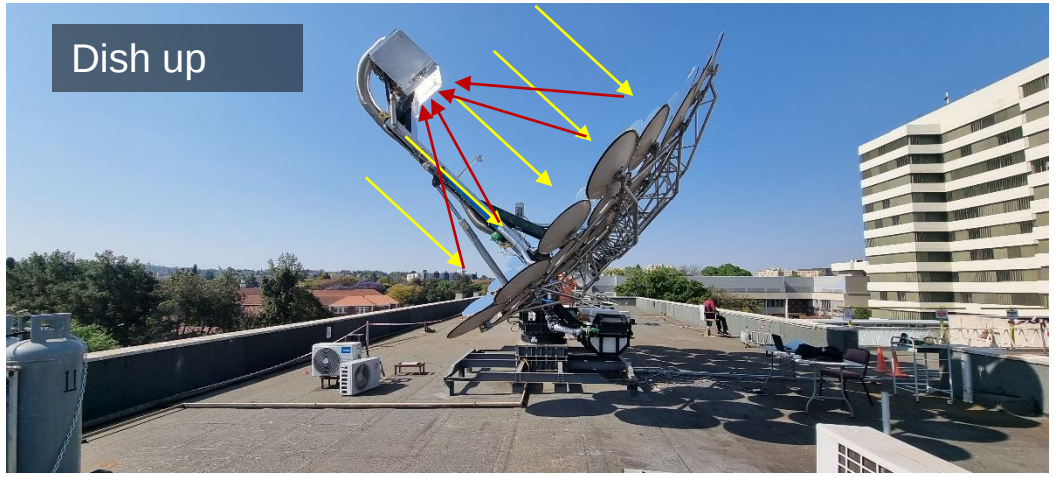
Off-road vehicle projects

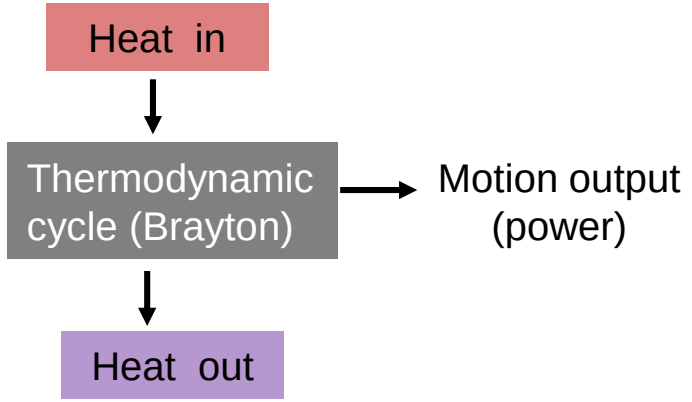
Assembly / mechatronics area

Car close-up

Area 7: Solar-Thermal Facility (roof-top)

Concentrated solar powered Brayton cycle.





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Admission Requirements

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YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Minimum admission requirements

Bachelor of Engineering in Mechanical Engineering:
Minimum requirements for NSC/IEB for 2025

APS: 35

Achievement levels required for specific subjects:

- English Home Language or English First Additional Language: **Level 5**
- Mathematics: **Level 6**
- Physical Sciences: **Level 6**

The suggested second-choice programmes for Bachelor of Engineering in Mechanical Engineering are Bachelor of Science *Chemistry*, Bachelor of Science *Mathematics* and Bachelor of Science *Physics* if your APS and subject requirements for your first-choice programme are not obtained.

- Application deadline: End of June
- Online application: www.up.ac.za/online-application

Application link:

MECHANICAL AND AERONAUTICAL ENGINEERING

Closing Remark:

We offer the opportunity, through analytical and creative thinking, to contribute towards the creation of a **competitive industry** and an improved environment to enhance the **quality of life** for the larger community.

MORE INFORMATION

DEPARTMENT OF :
MECHANICAL AND AERONAUTICAL ENGINEERING

www.me.up.ac.za

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Intro Disciplines Mechatronics Electives Candidate and industries Labs Admission