Creating an Integrated Curriculum for a STEM Discipline

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Brookes Philosophy

An ethos embedded within the University

“a goal of all formal education should be to graduate students to lead lives of consequence”

John Henry Brookes

1891 - 1975

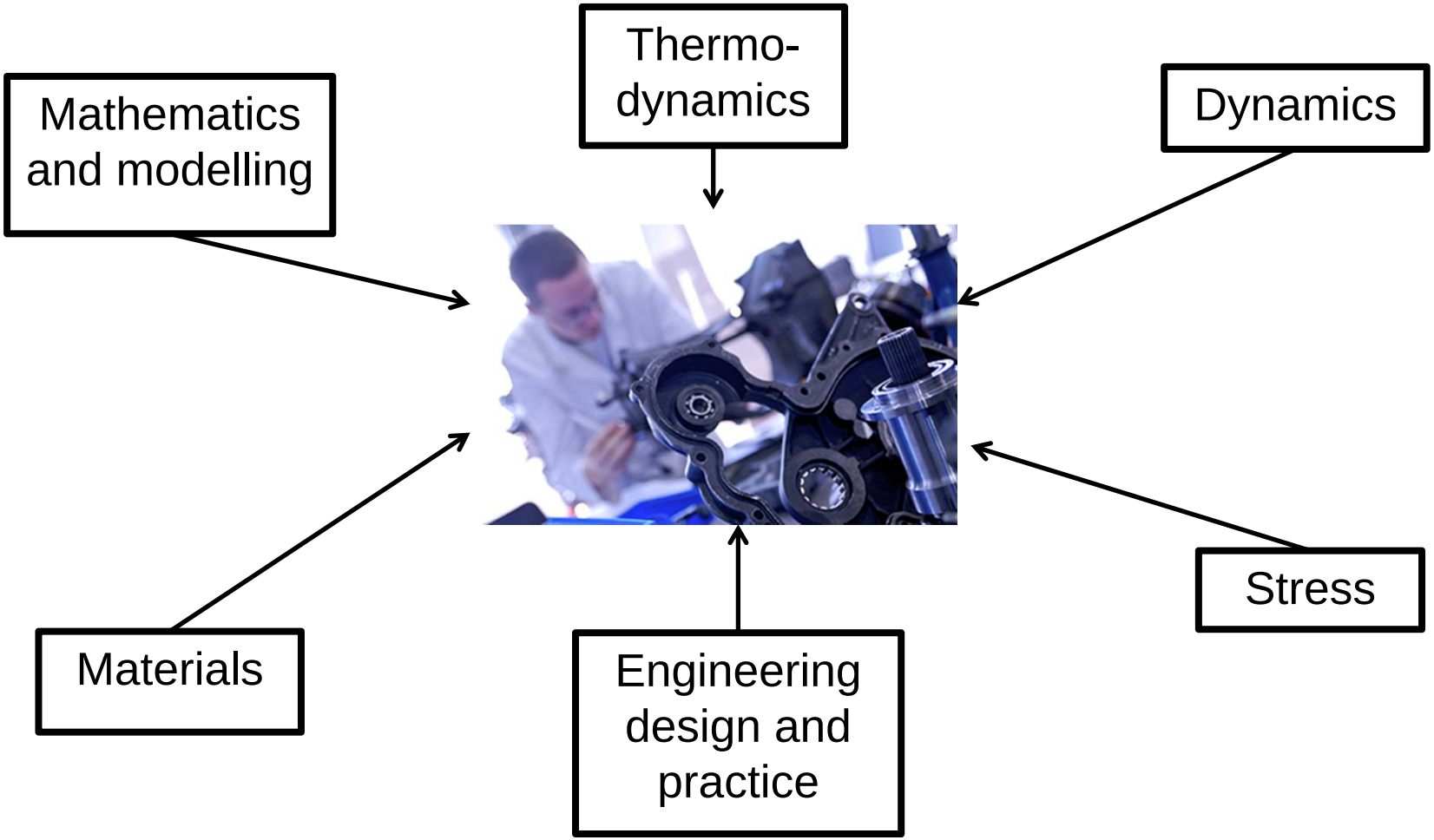
Pedagogical Approach

- An INTEGRATED curriculum is one that draws together all aspects of the curriculum and does not draw artificial boundaries between knowledge and learning in modules.

- An EXPLICIT curriculum is one where key learning outcomes are specifically assessed in modules deemed most appropriate for that assessment.

- INTEGRATED but EXPLICT refers to a curriculum that brings together all aspects of the programme but specifically targets explicit modules to assess core learning outcomes and skills.

What do Engineering Students have to Learn?



Inspirational Learning – Why is it necessary?

- Wide range of student ability
- Formula Student and similar competitive hands on activities satisfy students aspirations to practice engineering for real.
- Need for something else?

Industry Inspirational – Stirling Engine Project

DYNAMIC

ENVIRONMENTAL

ASTHETIC

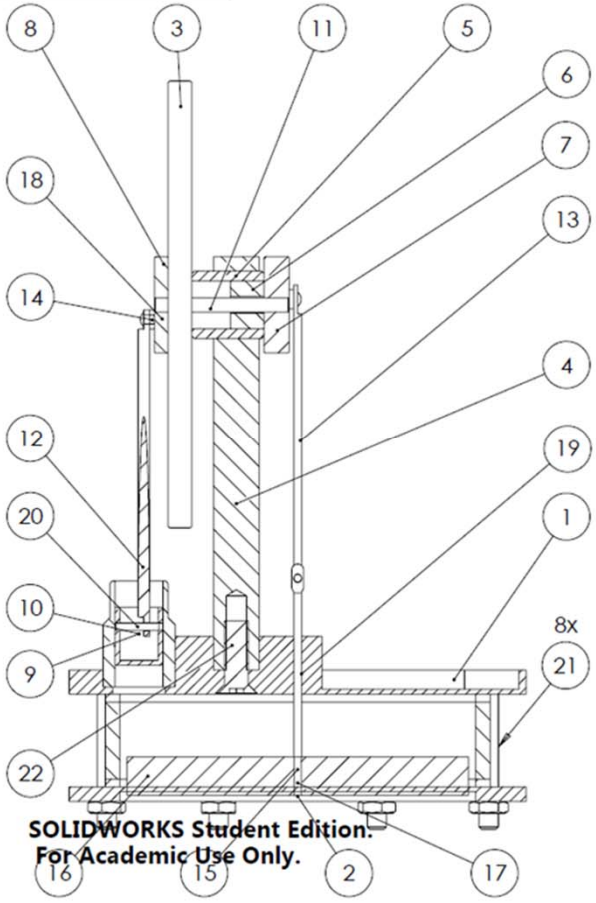
TANGEBLE

EXPLAINABLE

Industry Inspirational – Stirling Engine Project

Part No:

PROJECTION



ITEM NO.	PART NUMBER	QTY.
1	Top Plate	1
2	Bottom Plate	1
3	Flywheel	1
4	Column	1
5	Bearing Sleeve	1
6	Bearing Spacer	1
7	Outer Crank Wheel	1
8	Piston Crank Wheel	1
9	Piston Cylinder	1
10	Piston	1
11	Axle	1
12	Piston Con Rod	1
13	Displacer Con Rod	1
14	Spacer	2
15	Chamber	1
16	Displacer	1
17	Gasket	2
18	Crank Pin	2
19	Displacer Rod	1
20	Cylinder Rod	1
21	M4 Bolt	8
22	M5 Bolt	1
23	M4 Nut	8

SOLIDWORKS Student Edition:
For Academic Use Only.

SCALE: 1:1 | Drawn by: C.B. | OXFORD BROOKES UNIVERSITY

DIMENSIONS IN mm | Date:

TOLERANCE UNLESS STATED
0 ± 0.5
0.0 ± 0.25
0.00 ± 0.10

Checked by:

Approved by:

STIRLING ASSEMBLY

A4

MATERIAL: | Part No.

FINISH: | Sheet of

Exploiting the ‘Integrated but Explicit Curriculum’

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- Mechanics includes analysis of the components, the engine power and speed.
- Engine can be instrumented to provide real live data.
- Thermodynamics includes the Carnot cycle, modifications necessary to adapt it to be the Stirling cycle.
- Alternative Materials that can be used.
- Simple modifications for a non-optimised design.
- Mathematical models for position, displacement, acceleration, force, work and power.
- Analysis of dynamic properties, inertia, balance, power and friction

Related Pedagogical Inputs

- Suitable for students from a wide range of abilities.
- Can be manufactured in two days workshop time.
- Competitive element that students enjoy.
- Clear links in every module that refer to the project.

How does this Help Students Learn?

Confucius says:

“I hear and I forget. I see and I remember. I do and I understand.”

In todays world of Tertiary Education we can create our own saying to reflect this wisdom.

“I make and I enjoy. I study and I learn.

I study what I’m making and I enjoy learning.”

Industry Inspirational – Stirling Engine Project

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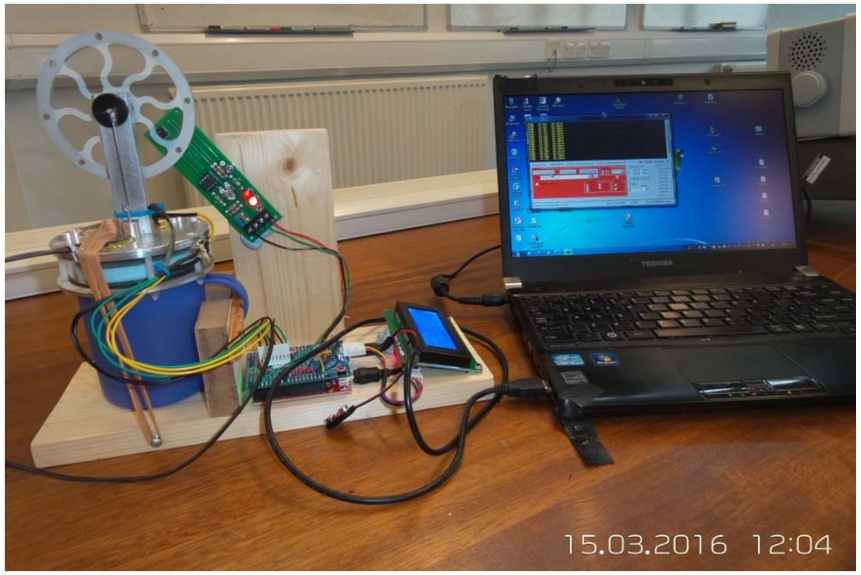
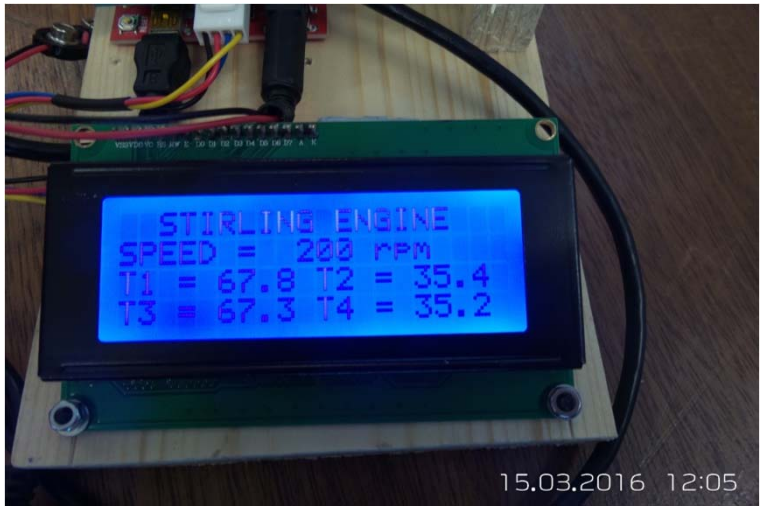
Instrumentation for speed and temperature



Temperatures and Speeds



Feedback from Students – Survey Questions

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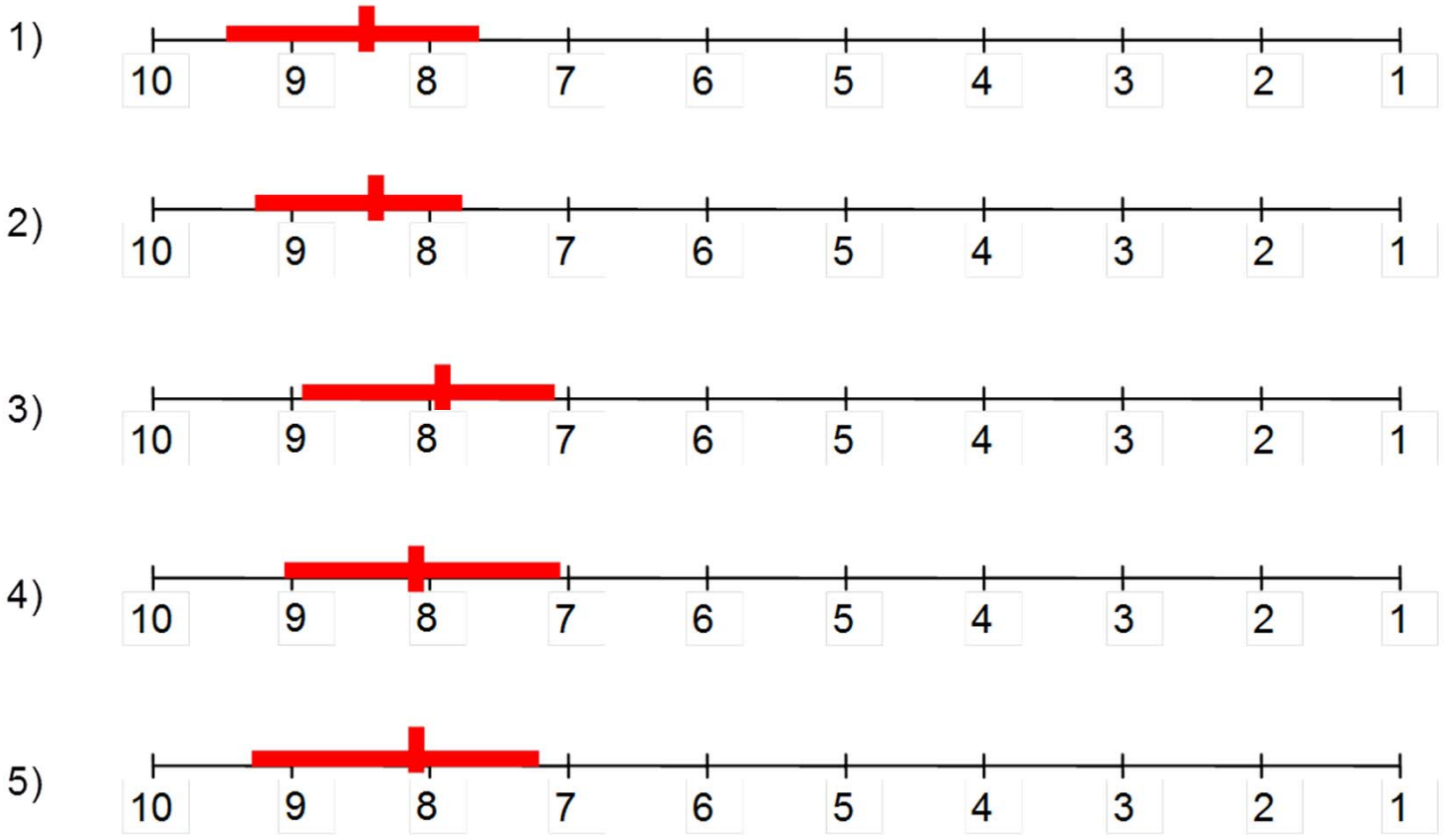
1. The timetable , organization of the week, lectures then problem sessions, lab day on Friday
2. Lab day, it's fun you are learning well vs it's not much fun, you're not learning much
3. The analytic subjects are good, I am learning and teaching is good vs I'm getting left behind and not coping.
4. I know what is expected of me and I know what I've got to do in order to do well vs I don't know what is expected of me and I don't know what I've got to do in order to well.
5. I feel I'm really getting to understand what engineering is all about vs I don't feel that I understand what engineering is all about.

Feedback from Students – Survey Questions



What they make

How a Gamma Configuration Stirling Engine works

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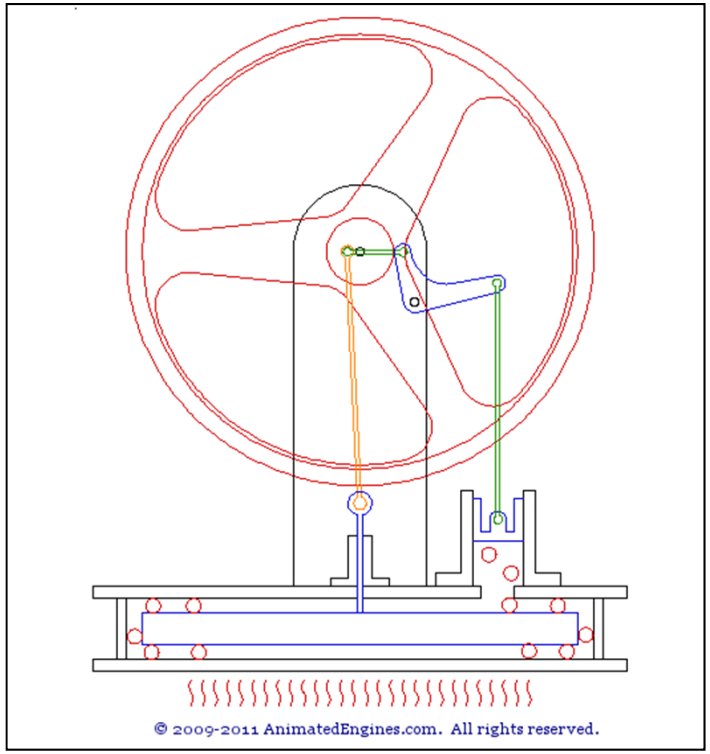
Workshop practice:

http://www.animatedengines.com/ltdstirling.html



“What we make!”

Josh Shires Mous inventor

F1 Renault (formerly Lotus)

Thanks & Further Information!

For further information:

http://mems.brookes.ac.uk

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