Integrated Mechatronic Project

Executive Specification

"To design, build, demonstrate and document a wire-following autonomous vehicle that will elegantly follow a course faster than all other competitors. To demonstrate to an employer that candidates are successfully able to bridge-the-gap between the underlying science and academic content of all second year modules and a practical task. To play, have fun, take risks, impress: get-on-with-it."

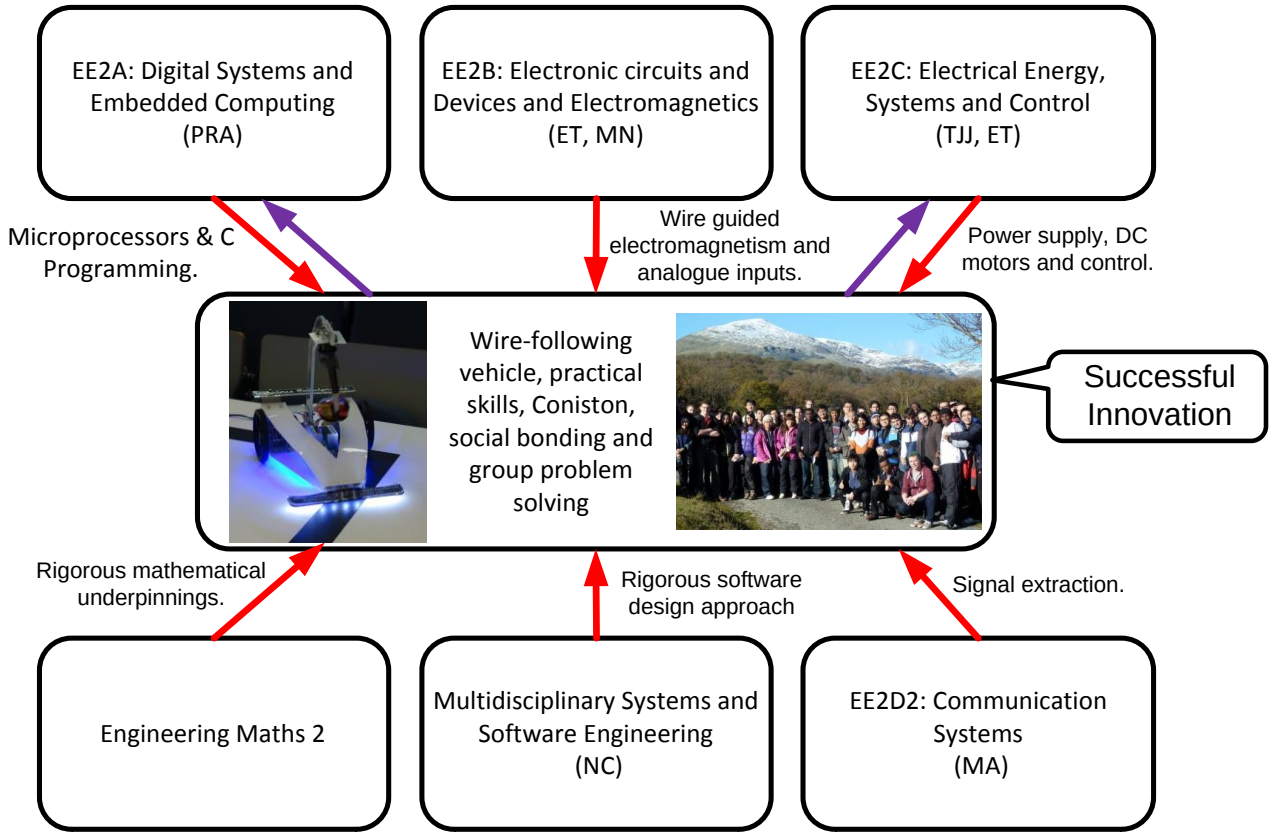
Introduction

The integrated mechatronic project is designed to:

- Maintain the very high employability rating of our students by giving them the ability to discuss technical detail with an employer at an interview.
- To maintain the social bonding and discipline ownership fostered by the Coniston trip.
- To introduce a demanding technical task where students will be required to teach themselves a wide range of practical and academic skills without these being covered within lectures.
- To provide training in the conduct and technical presentation of a final year project type activity.

Integration Across the Second Year

Employers often comment that students see academic modules as separate, stand-alone entities, rather than as a small part of an engineering continuum. Your task is to demonstrate that all technical aspects of the second year course can be integrated.

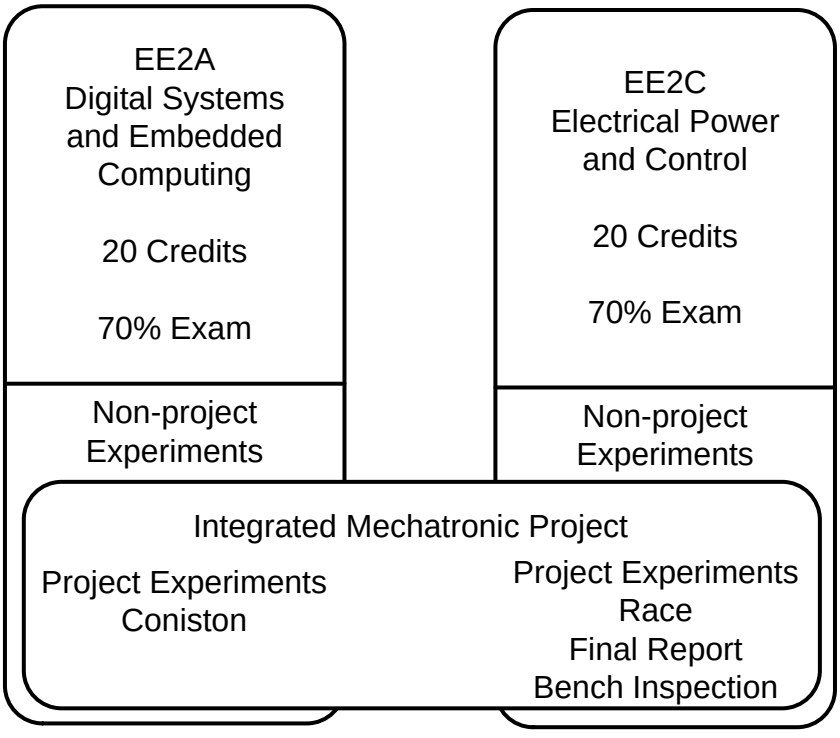


Assessment

The marks associated with the Integrated Mechatronic Project will be returned into the EE2A and EE2C module components. These module are as follows:

EE2A Digital Systems and Embedded Computing covering synchronous finite state machines, asynchronous finite state machines and microprocessors. The module will be examined by a 3-hour May/June paper worth 70% of the module and practical laboratory material worth 30%. As well as non-project experiments, a series of project sub-assemblies will be developed during this laboratory course and a component for the Coniston problem-solving session will comprise the 30% laboratory component.

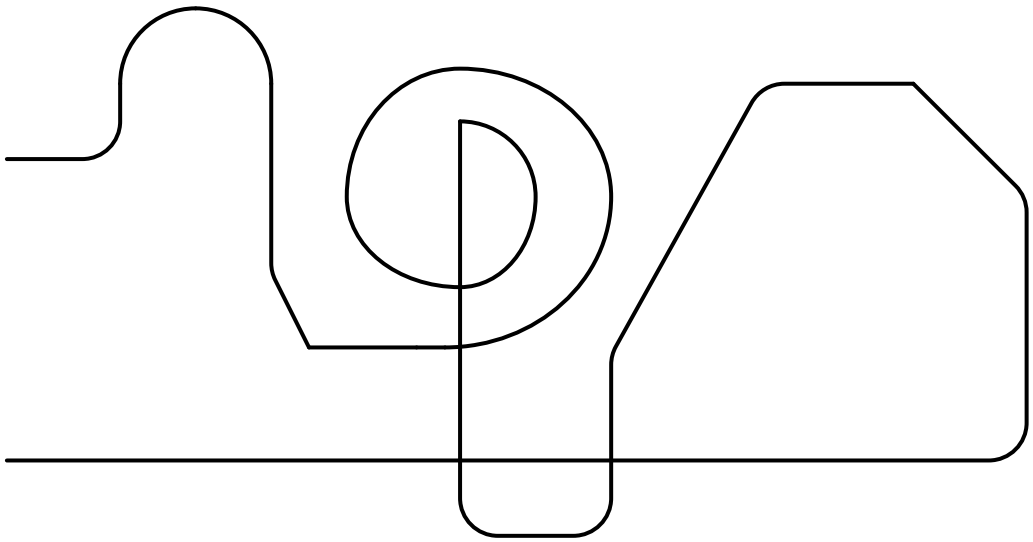
EE2C Electrical Power and Control covering power systems, rotating machines, control systems and system modelling. The module will be examined by a 3-hour May/June paper worth 70% of the module and practical laboratory material worth 30%. As well as non-project experiments, the final deliverables of the integrated mechatronic project will comprise the 30% laboratory component. These project marks will be weighted 70% for a final report written in the style of a scientific paper, 20% for a technical bench inspection and 10% on the outcome of the race.



Initial Technical Detail

Technical details and constraints will be kept to an absolute minimum, but will initially include:

- The project must be conducted in a safe manner – this implies that no harm must come to yourself, others, or the reputation of the University of Birmingham.
- The vehicle must elegantly track a wire carrying a peak current of 10 mA of a dual-tone (1 kHz and 2 kHz sinusoidal signal) mounted up to 30 mm below the race track. The wire depth may vary such that the amplitude may change over a 10:1 ratio.
- If the wire crosses itself, it will always cross at ninety degrees.
- Power will be supplied via a 3-phase umbilical in the voltage range 15 – 50 Volts and 2 Amps. The power supply frequency will be chosen such that the harmonics do not coincide with the navigation wire frequencies.
- **Safety: At no point during the project may voltages greater than 20 V be exposed**. This will be policed by staff attempting to short connections with a 3 mm diameter screwdriver blade (box up your power supplies robustly).



Typical track layout

Finer Detail

- Students should assemble themselves into self-selecting groups of three by half way through Week 3. These groups will be your EE2A laboratory groups throughout the year.
- Students should merge with a second group of three, to form an integrated mechatronic project group. This should be completed by the start of Week 5.
- You will attend Coniston in your group of six. You will be allowed to express a preference for the Monday-to-Wednesday, or Wednesday-to-Friday session.
- All students in a group will *normally* be awarded the same mark.
- In the Final Report, an Appendix will be included with one half-page per student. This must include a profile picture and a statement ‘I did this ….’. Obviously, your group members may disagree with your claims!

- An interim Bench Inspection will take place on Thursday/Friday, Week 11, Autumn term. This is a formative, uncredited, internal progression requirement. Failure of a student to attend or contribute to this event will remove the ability to obtain the 10% associated with the final race.
- Failure of a student to attend or contribute to the final race will remove the ability to obtain all the marks associated with the integrated mechatronic project.

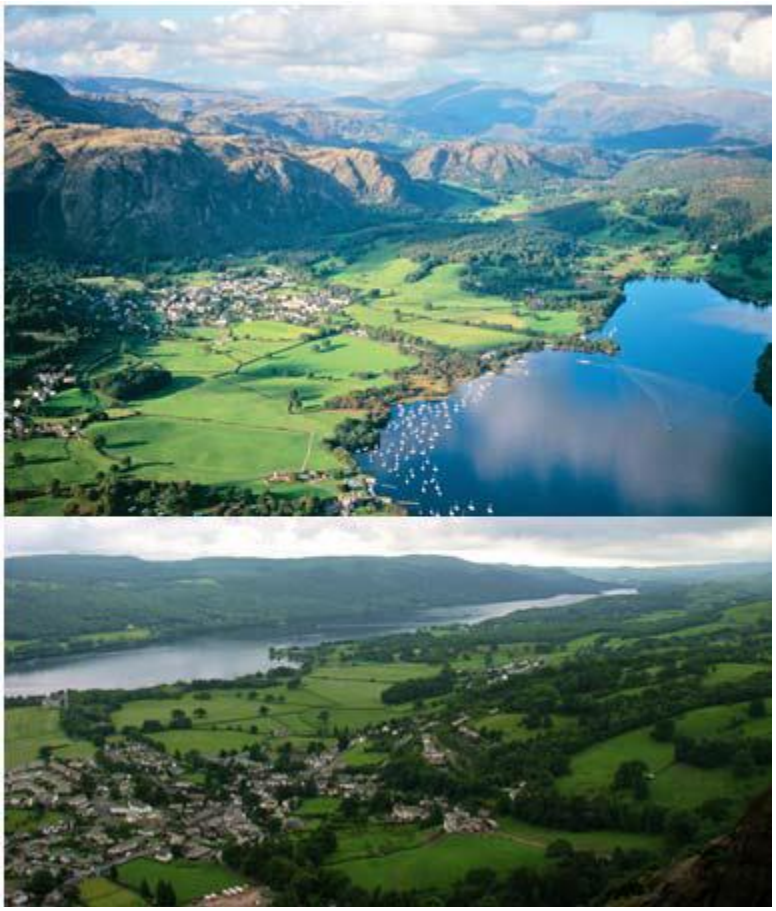
Coniston – The Raymond Priestly Centre

More details will be announced nearer the date.

The whole 2nd year will go to the University owned Raymond Priestley Centre at Lake Coniston in the Lake District. In exceptional circumstances, this activity is replaced by five days of 0900 – 1700 assessed laboratory activity.

The outdoor pursuits centre typically covers:

- Group problem solving
- Walking
- Climbing
- Mountain biking
- Gorge scrambling
- Sailing
- Canoeing
- Pub visit
- Self-reflection



Marking Schedule

Final Races

The final races will take place on Final Year Project Open Day, normally 1400, Thursday afternoon, Week 1 of the Summer Term. This activity is associated with 10% of the integrated mechatronic project. A vehicle able to move and adapt to the navigation wire will be awarded 40% for this component. The vehicle that traverses the wire most elegantly and at the highest speed will be awarded 100% for this component. Vehicles finishing the race will be awarded a mark between 40% and 100% based on their measured completion times.

Final Bench Inspection and Final Report

The final bench inspection is associated with 20% of the integrated mechatronic project. The final report is associated with 70% of the integrated mechatronic project. The assessors will be looking for: successful innovation, technical content, fun-content, professional approach and added value. These factors are assessed using grade descriptors that will be interpreted liberally by the assessors to suit the wide diversity of deliverables. The following grade descriptors are published to staff.

Degree class	Mark band	Characteristics
First class honours (1^{st})	1^{+} = >75 1^{-} = 70..74.99'	***Excellent*** Considerable capacity for original thinking; outstanding capacity to analyse and synthesize; outstanding grasp of subject matter; extensive knowledge base.
Upper second class honours (2.i)	$2.i^{+}$ = 65..69.99' $2.i^{-}$ = 60..64.99'	***Good*** Good grasp of subject matter, some evidence of originality, critical capacity and analytical ability; good understanding of relevant issues; good familiarity with the literature.
Lower second class honours (2.ii)	$2.ii^{+}$ = 55..59.99' $2.ii^{-}$ = 50..54.99'	***Satisfactory*** Satisfactory understanding of the subject matter; ability to develop solutions to straightforward problems.
Third class honours (3^{rd}) **= Fail at MEng**	3^{+} = 45..49.99' 3^{-} = 40..44.99'	***Marginal*** Minimally acceptable familiarity with subject matter, critical and analytical skills.
Failure **= Bad Fail at MEng**	35..39.99'	***Inadequate*** Insufficient understanding of the subject matter; weakness in critical and analytical skills; limited or irrelevant use of the literature.
Bad Fail	<35	***No Serious Attempt***
Blank – No Show	0	***No work submitted, or did not attend timetabled activities***