Module Description

The aim of this module is to give students and understanding of, and practice in, mathematical concepts and techniques that are important to both other modules in the programme and also to real world automation and robotics engineering.

It is a module on mathematical methods and techniques employed in the solution of problems in Engineering. The course deals with the purpose, methods and applications of differentiation, integration, matrices, differential equations and probability theory.

Learning Outcomes

On completion of this module the learner will/should be able to:

1. Differentiate single variable functions requiring a combination of rules.
2. Determine the partial derivatives of functions of two variables.
3. Apply differentiation to solve rates of change and optimisation problems.
4. Select and apply appropriate techniques of integration to evaluate integrals.
5. Solve first order differential equations by direct integration and separation of variables.
6. Analyse the behaviour of systems and processes in engineering to recognise when differential equations are appropriate, formulate the problem, creatively model these behaviours in order to solve the problems, interpret and clearly communicate the results.
7. Apply the rules of probability and use probability models for data analysis.

Indicative Syllabus

Integration Techniques
Integration by substitution, Integration by parts, Integration by partial fractions, Engineering applications of integration. Examples relevant to Automation and Robotics Engineering.

Differential Equations
Formulation and solution of first order differential equations, Direct integration, Variables separable, Integrating factor, Euler’s method, Second order differential equations, Homogenous and non-homogeneous differential equations, Engineering applications. Examples relevant to Automation and Robotics Engineering.

Partial Differentiation

Laplace Transforms
Definitions and notation, Derivation of Laplace transforms of common functions, Laplace transforms of derivatives, The first shift
theorem, Application to the solution of first and second order constant-coefficient linear differential equations. Examples relevant to Automation and Robotics Engineering.

**Probability and Statistics**

Probability, Discrete and continuous random variables, Sampling distributions, Confidence intervals.

**Teaching and Learning Strategy**

Lectures: Presentation of concepts with engineering examples (delivery is largely envisaged to be online but could include some face-to-face aspects).

Tutorials: Worksheets and quizzes with the primary goal to further develop understanding of the module content (delivery will involve independent study followed/proceeded by face-to-face class based interaction, but could also include some online aspects).

Laboratory Work: Graphing and Data Handling assignments (delivery will be face-to-face in a laboratory environment).

Independent Study: Study of provided module material with the primary goal to develop understanding of the module content via self centred learning. In addition to the weekly lectures/tutorials/labs, it is expected that students will also have to invest approximately 50 to 75 hours of independent study for completion of this module.

**Assessment Strategy**

Students will be assessed on the delivered material using a mixture of continuous assessments and a final exam.

Assessments will be designed to assess students:
- knowledge and understanding of the material.
- comprehension of the material.
- contextual application of knowledge.
- analysis and synthesis of material.
- evaluation of outcomes.

**Repeat Assessment Strategies**

Repeat of the final exam will be offered.

**Indicative Coursework and Continuous Assessment:**

<table>
<thead>
<tr>
<th>Form</th>
<th>Title</th>
<th>Percent</th>
<th>Week (Indicative)</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Continuous Assessments</td>
<td>30 %</td>
<td>OnGoing</td>
<td>1,2,3,4,5,6,7</td>
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</tbody>
</table>

**End of Semester / Year Formal Exam:**

<table>
<thead>
<tr>
<th>Form</th>
<th>Title</th>
<th>Percent</th>
<th>Week (Indicative)</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Book Exam</td>
<td>Final Exam</td>
<td>70 %</td>
<td>End of Term</td>
<td>1,2,3,4,5,6,7</td>
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**Blended Delivery Mode Average Weekly Workload:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Location</th>
<th>Hours</th>
<th>Frequency</th>
<th>Weekly Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Lecture/Tutorial</td>
<td>Lecture Theatre</td>
<td>1</td>
<td>Weekly</td>
<td>1.00</td>
</tr>
<tr>
<td>Lecture</td>
<td>Lecture</td>
<td>Online</td>
<td>1</td>
<td>Weekly</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Recommended Reading Book List**


### Journal Resources
To be provided during module delivery (if required).

### Online Resources
To be provided during module delivery (if required).

### Other Resources
To be provided during module delivery (if required).

### Programme Membership
| GA_EAURG_B07 202000 Bachelor of Engineering in Automation & Robotics |
| GA_EAURG_C06 202000 Higher Certificate in Engineering in Automation & Robotics |