### COURSE DETAILS

**Course Code:** F19AB  
**Full Course Title:** Applied Mathematics B  
**SCQF Level:** 9  
**SCAF Credits:** 15  
**Available as Elective:** No

### DELIVERY LEVEL

<table>
<thead>
<tr>
<th>Undergraduate:</th>
<th>Yes</th>
<th>Postgraduate Taught:</th>
<th>Yes</th>
<th>Postgraduate Research:</th>
<th>No</th>
</tr>
</thead>
</table>

### COURSE AIMS

The objective of the module is to introduce some fundamental ideas and techniques in Applied Mathematics.

### LEARNING OUTCOMES – SUBJECT MASTERY

By the end of the course, students should be able to:

- find the Fourier sine and cosine series of simple functions on $[-L, L]$
- find the half-range Fourier sine and cosine series of functions on $[0, L]$
- understand the concept of a PDE
- understand the meaning and application of the heat, Laplace's and wave equations
- understand and be able to use the separation of variables approach
- solve the heat equation in 1D with various boundary conditions using separation of variables and Fourier analysis
- solve Laplace's equation in 2D with various boundary conditions using separation of variables and Fourier analysis
- solve the wave equation with various initial conditions using separation of variables and Fourier analysis
- derive the Euler–Lagrange equations for the extremizer of a functional
- solve the Euler–Lagrange equations for simple examples
- perform both of the previous two exercises for functionals involving higher derivatives and/or more than one dependent and/or independent variables
- use Lagrange multipliers to solve problems with constraint
- define action and state Hamilton's Principle
- derive Lagrange's equations of motion and use them to solve for the dynamics of simple examples, e.g. Kepler and simple pendulum problems
- derive Hamilton's equations
- understand Poisson brackets
- exploit symmetries to solve simple mechanics problems
- understand the relation between symmetries and conservation laws

### LEARNING OUTCOMES – PERSONAL ABILITIES

- Demonstrate the ability to learn independently
- Demonstrate knowledge of an area of mathematics.
- Manage time, work to deadlines and prioritise workloads
SYLLABUS

Fourier Analysis: Full and half range Fourier series.

An introduction to PDEs: Simple PDEs; Separation of Variables; Solution of the heat equation, Laplace's equation and the wave equation making use of Fourier series.

Calculus of variations: variational derivative; Euler–Lagrange equations; examples including the Brachistochrone, isoperimetrical, and soap bubble problems; extensions to higher derivatives, several dependent and independent variables; constraints and La-grange multipliers.

Lagrangian mechanics: action; Hamilton's Principle; Lagrange's equations; examples including the Kepler and simple pendulum problems; Poisson brackets; Noether's theorem.

COURSE RELATIONSHIPS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>F18CD</td>
<td>8</td>
<td>Multivariable Calculus and Real Analysis A</td>
<td>School of Math and Comp Sci.</td>
<td>Pre-Requisite</td>
</tr>
</tbody>
</table>

LOCATION AND ASSESSMENT METHODS

<table>
<thead>
<tr>
<th>Edi</th>
<th>SBC</th>
<th>Ork</th>
<th>Dub</th>
<th>Malay</th>
<th>IDL</th>
<th>COLL</th>
<th>ALP</th>
<th>OTH</th>
<th>Method</th>
<th>Weight</th>
<th>Exam Mins</th>
<th>Type</th>
<th>Diet</th>
<th>Synoptic Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Examination</td>
<td>85</td>
<td>120</td>
<td>Assessment</td>
<td>Semester 2</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Coursework</td>
<td>15</td>
<td></td>
<td>Assessment</td>
<td>Semester 2</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Examination</td>
<td>100</td>
<td>120</td>
<td>Reassessment</td>
<td>Semester 3</td>
<td></td>
</tr>
</tbody>
</table>