Numerical Methods

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Numerical Methods</th>
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<tbody>
<tr>
<td>Level</td>
<td>4</td>
</tr>
<tr>
<td>Reference No.</td>
<td>EAX_4_219/MTHE02I03</td>
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<tr>
<td>Credit Value</td>
<td>10 credit points</td>
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**Student Study Hours**

- Contact hour: 22 lectures + 11 Tutors + 11 practical computer sessions
- Student managed learning hours: 100

**Pre-requisite learning**

- 

**Co-requisites**

- 

**Excluded combinations**

- 

**Module co-ordinator**

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**Faculty/Department**

Engineering/Petroleum Engineering

**Short Description**

numerical, mathematics, programming.

**Aims**

are to ensure that all students will have a basic knowledge and understanding of how to set up and solve mathematical problems numerically.

**Learning Outcomes**

**Knowledge and Understanding:**

On completion of this module students should be able to demonstrate knowledge and understanding of:

1. understand how mathematical models can be solved using computer simulations;
2. understand limits of numerical methods and their implementation on computer systems; understand sources of numerical error and be able to estimate its effect on a given algorithm;

**Intellectual Skills:**

On completion of this module students should be able to demonstrate ability in:

3. explaining the mathematical concepts for each topic in this module using specialist vocabulary; follow, replicate and explain simple proofs from the lecture notes;
4. selecting suitable numerical method for solving eng math problem

**Practical Skills:**

On completion of this module students should be able to demonstrate ability in:

5. mathematically solve practical engineering problems using computational methods;
6. apply different numerical techniques for solving partial differential equations.

**Transferable Skills:**

On completion of this module students should be able to demonstrate ability in:

7. write simple computer programmes in order to solve mathematical problems;
8. solve PDF equations for eng purposes.
### Employability

The development of one or more of the top engineering skills, namely problem solving, communication, management and environment and economics, is the priority of this module.

### Teaching and learning pattern

1. 22, 1 hr lectures. This method informs learning outcomes 1, 2, 3.
2. 11, 1 hr tutorials. This method informs learning outcomes 2, 4, 5, 6, 7, 8.
3. 11, 1 hr practical computer sessions. This method informs learning outcomes 4, 5, 6.

### Indicative content

Types of errors; algorithms and convergence; solution of nonlinear equations in one variable using bisection and Newton-Raphson; solution of linear systems using iteration methods, the Jacobi, and the Gauss-seidel; interpolation and polynomial approximation using Lagrange, Newton divided differences, Newton forward and backward, central differences; least square regression, numerical integration using trapezoidal and Simpson, numerical solution of ordinary differential equations using Euler's method, Runge-Kutta, and multi-step methods.

### Assessment

<table>
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<tr>
<th>Elements &amp; weightings</th>
<th>Description</th>
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<tr>
<td>Examination</td>
<td>A 180-minute unseen written examination assesses learning outcomes 1, 2, 3. 70%</td>
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<tr>
<td>Course Work</td>
<td>10% one set of assessed tutorial problems to assess learning outcomes 1, 2, 4, 5, 6 and 20% a computer-based project assesses learning outcomes 4, 5, 6. 30%</td>
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Students must achieve (i) 40% for the total module mark and (ii) at least 30% in the unseen examination and the course work in order to achieve an overall passing mark for this module.

### Indicative Sources