 MODULE DESCRIPTION FORM

ME404  Energy Systems Modelling

Module Registrar: Prof J A Clarke  
Taught To (Course): Cohorts for whom class is compulsory
Other Lecturers Involved: none
Credit Weighting: 10 (ECTS 5)
Semester: 2
Assumed Prerequisites: One or more of the following as appropriate: 16293 Environmental Engineering Science 1, 16387 Environmental Engineering Science 2, ME405 Heat and Flow 4
Compulsory class
Academic Level: 4

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Tutorial</th>
<th>Laboratory</th>
<th>Groupwork</th>
<th>External</th>
<th>Online</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>24</td>
<td>12</td>
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<td>64</td>
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Educational Aim

The aim of this class is to introduce students to the assumptions and limitations that underlie state-of-the-art modelling methods as currently used to appraise the performance of buildings, their associated environmental control plant, and renewable energy technologies suitable for deployment at the urban scale. Essentially, the class describes mathematical models for the underlying heat and mass transfer processes, along with numerical methods by which these process models may be conflated to form an integrated simulation program. Finally, the range of possible applications of integrated energy simulation is explored.

Learning Outcomes

On completion of the module the student is expected to be able to appreciate the capabilities and limitations of the various methods for assessing the dynamic behaviour of complex energy systems comprising buildings and conventional and renewable systems for heating, cooling and power supply.

LO1 appreciate that environments result from a complex interaction of many heat and mass transfer mechanisms.

LO2 have a basic knowledge of how to apply modelling and simulation to address this complexity.

LO3 understand the theoretical and operational principles underlying contemporary energy modelling programs.

LO4 appreciate the limitations of current design tools and the issues to be addressed to bring about their improvement.

Syllabus

Introduction: the need for simulation, types of energy system, energy transfer mechanisms, dynamic modelling techniques, performance assessment criteria.

Boundary conditions: weather parameters, severity assessment and radiation prediction.

Integrative modelling techniques: response function and numerical methods.

Numerical simulation – buildings: discretisation, conservation equations, domain integration by linking domain equations, imposing control and solving simultaneously the whole-system equation-set.

Numerical simulation – energy supply plant and control: HVAC and renewable energy conversion systems, control systems.

Numerical simulation – air, moisture and electricity flow: nodal network approach and computational fluid dynamics.

Convection heat exchange: buoyancy driven and forced convection at internal and external surfaces.
Radiation heat exchange: Long- and short-wave radiation at external and internal surfaces.

Modelling issues: Validity, applicability, user interfaces, use in practice, performance assessment method, uncertainty.

Tutorials: These will cover specific examples of the knowledge and theory that will comprise the final examination.

Private Study: Students are invited to deepen their learning by studying the material at www.esru.strath.ac.uk/courseware.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1
C1: evidence that the student understands the interacting energy/mass flows – as judged by specific exam questions and performance at group debates.

LO2
C1: evidence that the student understands the processes involved in applying modelling and simulation in practice – as judged by specific exam questions and performance at group debates.

LO3
C1: evidence that the student understands the theoretical approaches to modelling energy systems – as judged by specific exam questions and performance at group debates.

LO4
C1: evidence that the student understands the limitations of existing design tools and the research underway to address these – as judged by specific exam questions and performance at group debates.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

12 Principles of Assessment and Feedback

Formal, summative feedback will be provided by the return of examination marks to students after assessment.

Informal feedback will be provided at weekly tutorial sessions through discussion with individuals or groups on tutorial exercises attempted in advance.

Students will also receive weekly verbal feedback in the context of group discussions with supervising staff.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
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<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Month(s)</td>
<td>Duration</td>
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<tr>
<td>All</td>
<td>1</td>
<td>May/Jun</td>
<td>2 hours</td>
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Indicate which learning outcomes (LO1, LO2 etc) are to be assessed by exam/coursework/project as required.
**Coursework / Submissions deadlines:**
TBA

**Resit Assessment Procedures:**
2 hour examination in August.

**PLEASE NOTE:**
Students need to gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

**Recommended Reading**

- [http://www.esru.strath.ac.uk/courseware.htm](http://www.esru.strath.ac.uk/courseware.htm)

**Additional Student Feedback**
(Please specify details of when additional feedback will be provided)

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Session: 2014/15

**Approved:**

**Course Director Signature:**

**Date of Last Modifications:** 02 September 2014
# MODULE TIMETABLE

**Module Code:** ME404  
**Module Title:** Energy Systems Modelling

**Brief Description of Assessment:**

2 hour examination in May diet.

**Assessment Timing:**

Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment(s).

<table>
<thead>
<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
<th>WK5</th>
<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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