**UNIVERSITY OF WARWICK**

**Proposal Form for New or Revised Modules (MA1 - version 7 - April 2014)**

| Approval information | |
|---|---|
| **Approval Type** | ☐ New module ☒ Revised module<br>☐ Discontinue module |
| **Date of Introduction/Change** | 1 October 2018 |
| **If new, does this module replace another? If so, enter module code and title:** | |
| **If revised/discontinued, please outline the rationale for the changes:** | Lectures reduced and laboratory hours increased. |
| **Confirmation that affected departments have been consulted:** | Changes were made in consultations between the School of Engineering and WMG. |

| Module Summary | |
|---|---|
| **1. Module Code (if known)** | ES4C3 |
| **2. Module Title** | Mathematical and Computer Modelling |
| **3a. Lead department:** | School of Engineering |
| **3b. Teaching Split (if known):** | 100% Engineering |
| **4. Name of module leader** | Dr Igor Khovanov |
| **5. Level** | UG: ☐ Level 4 (Certificate) ☐ Level 5 (Intermediate) ☐ Level 6 (Honours)<br>PG: ☒ Level 7 (Masters) ☐ Level 8 (Doctoral)<br>See Guidance Notes for relationship to years of study |
| **6. Credit value(s) (CATS)** | 15 credits |
| **7. Principal Module Aims** | To provide the theoretical background to basic and advanced modelling techniques and computational methods as used in engineering and to provide the necessary software application skills for using the techniques and methods in Matlab environment. |

| Module Summary | |
|---|---|
| **8. Principal Learning Outcomes** | By the end of the module the student should be able to:<br>1. Built or select mathematical models over a wide range of application areas in engineering.<br>2. Intelligently select and use suitable computational methods and software systems for engineering tasks.<br>3. Evaluate the principles, purpose, and limitations of models and computational methods used in engineering software.<br>4. Implement, evaluate and use key computational methods in Matlab environment. |
| **9. Timetabled Teaching Activities (summary)** | 16 x 1hr lectures<br>7 x 2hr Computational Laboratories<br>2 x 1hr revision classes<br>**TOTAL 32 Hours** |
| **10. Departmental Web-link** | http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4 |
| **11. Other essential notes** | Advice and feedback hours are available for answering questions on the module |
| **12. Assessment methods (summary)** | 2 hour Written examination (50%)<br>Worksheet based on Laboratory Classes (Coursework) (15%)<br>Assignment (computational exercise) (35%)<br>**Students must pass individual coursework elements** |

**For use by Strategic Planning and Analytics Office only - Do not fill in this section**

| Level | JACS3 Code | Teaching Split |
|---|---|---|
| | | *If not provided in 3b above* |

| External Credit Level | | Scheme | |
|---|---|---|---|

## Module Context

**13. Please list all departments involved in the teaching of this module. If taught by more than one department, please indicate percentage split.**

100% School of Engineering

**14. Availability of module**

| Degree Code | Title | Study Year | C/OC/ A/B/C | Credits |
|---|---|---|---|---|
| **H107** | **MEng Engineering (plus variants)** | **4** | **O** | |
| **H109** | **MEng Engineering with Intercalated Year (plus variants)** | **5** | **O** | |
| **H110** | **MEng Engineering with a Year in Research (plus variants)** | **5** | **O** | |
| **New** | **MEng Engineering with Exchange Year** | **4** | **O** | |
| **HH63** | **MEng Systems Engineering (plus variants)** | **4** | **O** | |
| **HH64** | **MEng Systems Engineering with Intercalated Year (plus variants)** | **5** | **O** | **15** |
| **HH65** | **MEng Systems Engineering with Year in Research (plus variants)** | **5** | **O** | |
| **New** | **MEng Systems Engineering with Exchange Year** | **4** | **O** | |
| **H311** | **MEng Mechanical Engineering (plus variants)** | **4** | **O** | |
| **H312** | **MEng Mechanical Engineering with Intercalated Year (plus variants)** | **5** | **O** | |
| **H313** | **MEng Mechanical Engineering with Year in Research** | **5** | **O** | |
| **H320** | **MEng Mechanical Engineering with Exchange Year** | **4** | **O** | |
| **H341** | **MSc Advanced Mechanical Engineering** | **1** | **C** | |

**15. Minimum number of registered students required for module to run**

**1 (Core)**

**16. Pre- and Post-Requisite Modules**

## Module Content and Teaching

**17. Teaching and Learning Activities** *(totals for module – please see guidance)*

| | |
|---|---|
| **Module duration (weeks)** | **10** |
| **Lectures** | **16x1hr** |
| **Seminars** | |
| **Tutorials** | **0** |
| **Project Supervision** | 0 |
| **Demonstration** | 0 |
| **Practical Class/Workshops** | **7x2hr** |

| Module Content and Teaching | | |
|---|---|---|
| **Supervised time in studio/workshop** | 0 | |
| **Fieldwork** | 0 | |
| **External visits** | 0 | |
| **Work based learning** | 0 | |
| **Placement** | **0** | |
| **Year abroad** | **0** | |
| **Other activity** *(please describe): e.g. distance-learning, intensive weekend teaching etc.* | **2 x 1hr revision classes**<br>**118 hours guided independent learning** | |
| **18. Assessment Method (Standard)** | | |
| **Type of assessment** | **Length** | **% weighting** |
| **Written Examinations** | 2 Hours | **50%** |
| **Practical Examinations** | | |
| **Assessed essays/coursework** | Worksheet based on Laboratory Classes (coursework)<br><br>Assignment (Computational Exercise) | **15%**<br><br>**35%** |
| **18a. Final chronological assessment** *(please see guidance*) | **Examination** | |

**19. Methods for providing feedback on assessment.**

- Model solutions to past papers.
- Support through advice and feedback hours.
- Written feedback on assignment and coursework.
- Cohort-level feedback on assignment and coursework.
- Cohort-level feedback on final exam.

**20. Outline Syllabus**

*Introduction to Modelling and Problem Solving Techniques*
o *Computers and Software. Approximations and errors*
*o Linear versus nonlinear systems: Linear and Non-linear resonance, Self-oscillations, Bifurcations*

*• Data driven models*
*o Interpolation and Extrapolation*
*o Least-squares regression*
*o Curve fitting*

• *Roots of nonlinear equation*
*o Bracketing methods*
*o Open methods*

• *Computational differentiation and integration*
*o Finite-difference approximation of derivatives*
*o Computation of derivatives via interpolation and extrapolation*
*o Newton-Cotes versus Gauss quadrature*

• *Numerical solution of ordinary differential equations*
*o Initial value problem*
*o Boundary value problem*

• *Partial-Differential Equations*
*o Classification, initial and boundary conditions*
*o Finite-difference methods*
*o Iterative methods for solution of linear matrix equation and their application for solving partial differential equations*
*o Finite-element approach*

Each topic includes illustrative examples and templates of Matlab scripts for relevant modelling and computational techniques.

**21. Illustrative Bibliography**

1. Jaan Kiusalaas, "Numerical methods in engineering with MATLAB", Cambridge Press, 2010, e-book format.
2. A. Gialt and V. Subramaniam, "Numerical methods for engineers and scientists: An introduction with Applications using MATLAB", New York : Wiley, 2008.
3. S.S. Rao, Applied Numerical Methods for Engineers and Scientists, Prentice Hall, 2002.
4. Won Young Yang and others, Applied numerical methods using MATLAB, Willey, 2005, e-book format.
5. Steven H. Strogatz, Nonlinear dynamics and chaos : with applications to physics, biology, chemistry, and engineering, Westview Press, 2015, e-book format.
6. Douglas Thorby, Structural dynamics and vibration in practice : an engineering handbook, Elsevier, 2008, e-book format.

**22. Learning outcomes**

*Successful completion of the module leads to the learning outcomes. The learning outcomes identify the knowledge, skills and attributes developed by the module.*

*Learning Outcomes should be presented in the format "By the end of the module students should be able to..." using the table at the end of the module approval form:*

| Resources |
|---|
| **23. List any additional requirements and indicate the outcome of any discussions about these.** |
| Computer Class<br>Software: Matlab, Microsoft Office |

| Approval | |
|---|---|
| **24. Module leader's signature** | Dr Igor Khovanov |
| **25. Date of approval** | 20 March 2018 |
| **26. Name of Approving Committee (include minute reference if applicable)** | School of Engineering and WMG Course and Module Approval Committee Minute 161-17/18 |
| **27. Chair of Committee's signature** | Professor Gillian Cooke |
| **28. Head of Department(s) signature** | Professor David Towers |

| Examination Information | | |
|---|---|---|
| **A1. Name of examiner (if different from module leader)** | | |
| **A2. Indicate all available methods of assessment in the table below** | | |
| **% Examined** | **% Assessed by other methods** | **Length of examination paper** |
| **50** | **15% Worksheet based on Laboratory Classes**<br>**35% Assignment (Computational Exercise)** | **2 hours** |
| **A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.** | | |
| | | |
| **A4. How many papers will the module be examined by?** | ☒ 1 paper | ☐ 2 papers |
| **A5. When would you wish the exam take place (e.g. Jan, April, Summer)?** | **Summer** | |
| **A6. Is reading time required?** | ☐ Yes | ☒ No |
| **A7. Please specify any special exam timetable arrangements.** | | |
| | | |
| **A8. Stationery requirements** | | |
| **No. of Answer books?** | **1** | |
| **Graph paper?** | **N** | |
| **Calculator?** | **Student approved** | |
| **Any other special stationery requirements (e.g. Data books, tables etc)?** | **Engineering Data Book** | |
| **A9. Type of examination paper** | | |
| **Seen?** | ☐ Yes | ☒ No |
| **Open Book?** | ☐ Yes | ☒ No |

| Examination Information | | |
|---|---|---|
| **Restricted?** | ☐ Yes | ☒ No |
| **If restricted, please provide a list of permitted texts:** | | |

| LEARNING OUTCOMES | | |
|---|---|---|
| **(By the end of the module the student should be able to....)** | **Which teaching and learning methods enable students to achieve this learning outcome? (reference activities in section 17)** | **Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)** |
| Build or select mathematical models over a wide range of application areas in engineering. | Lectures, examples sheets | Examination and assignment |
| Intelligently select and use suitable computational methods and software systems for engineering industrial tasks. | Lectures, examples sheets, computational laboratories | Examination and assignment, laboratory coursework |
| Evaluate the principles, purpose, and limitations of models and computational methods used in engineering software. | Lectures, examples sheets, computational laboratories | Examination and assignment, laboratory coursework |
| Implement, evaluate and use key computational methods in Matlab environment. | Lectures, examples sheets, computational laboratories | Examination and assignment, laboratory coursework |