**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** | 01/10/2018 |
| **If new, does this module replace another? If so, enter module code and title:** | |
| **If revised/discontinued, please outline the rationale for the changes:** | Contact hours are changed from 57 hours to 45 hours; formative tests removed; assessment changed to 60% 2-hour examination and 40% coursework (2 x 20% laboratory based assessment) |
| **Confirmation that affected departments have been consulted:** | Changes have been made in consultations between the School of Engineering and WMG |

| Module Summary | |
|---|---|
| **1. Module Code (if known)** | ES2C5 |
| **2. Module Title** | Dynamics and Fluid Mechanics |
| **3a. Lead department:** | School of Engineering |
| **3b. Teaching Split (if known):** | 100% School of Engineering |
| **4. Name of module leader** | Professor Peter Thomas |
| **5. Level** | UG: ☐ Level 4 (Certificate) ☒ Level 5 (Intermediate)<br>☐ Level 6 (Honours)<br>PG: ☐ Level 7 (Masters) ☐ Level 8 (Doctoral)<br><br>See Guidance Notes for relationship to years of study |
| **6. Credit value(s) (CATS)** | 15 credits |
| **7. Principal Module Aims** | The principal aims of the module are to develop upon a firm understanding of mechanical concepts from the first year. Furthermore the module aims to generate a familiarity with key techniques used in the analysis and testing of mechanical systems, and then to introduce fundamental concepts underpinning solid and fluid dynamics. |

| Module Summary | |
|---|---|
| **8. Principal Learning Outcomes** | By the end of the module the student should be able to:<br>• Show a developed ability in the analysis of rigid body planar motion. Understand that forces maybe either conservative or non-conservative and appreciate how these apply in modelling real-world applications.<br>• Employ the principles of work and energy as a means to generate governing equations and evaluate system response.<br>• Perform kinematic and kinetic analysis of rigid bodies employing vector methods and graphical solutions as appropriate.<br>• Demonstrate knowledge and understanding of the rudimentary equations of fluid mechanics and be able to classify different types of flow regime and fluid behaviour using appropriate dimensionless numbers.<br>• Apply Bernoulli's principle to a range of applications to predict inviscid fluid-flow behaviour, while being able to identify its limitations. Show appreciation for extensions to fluid mechanics theory, e.g. compressibility, surface tension.<br>• Analyse experimental measurements of velocity and pressure, and be able to quantify and analyse the various forms of error. |
| **9. Timetabled Teaching Activities (summary)** | 30 x 1 hour lectures<br>2 x 1 hour Revision classes<br>3 x 3 hour laboratory sessions<br>1 x 2 hour laboratory session<br>2 x 1 hour lab brief/de-brief<br>**Total 45 hours** |
| **10. Departmental Web-link** | http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year2/ |
| **11. Other essential notes** | Advice and feedback hours are available for answering questions on the lecture material and past examination questions |
| **12. Assessment methods (summary)** | 60% 2 hour examination<br>2 x 20% laboratory based assessment |

**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 |
|---|---|---|---|---|
| H113 | BEng Engineering | 2 | C | 15 |
| H114 | MEng Engineering | 2 | C | 15 |
| H161 | BEng Biomedical Systems Engineering | 2 | C | 15 |
| H163 | MEng Biomedical Systems Engineering | 2 | C | 15 |
| H216 | BEng Civil Engineering | 2 | C | 15 |
| H217 | MEng Civil Engineering | 2 | C | 15 |
| H315 | BEng Mechanical Engineering | 2 | C | 15 |
| H316 | MEng Mechanical Engineering | 2 | C | 15 |
| H335 | BEng Automotive Engineering | 2 | C | 15 |
| H336 | MEng Automotive Engineering | 2 | C | 15 |
| H605 | BEng Electrical and Electronic Engineering | 2 | C | 15 |
| H606 | MEng Electrical and Electronic Engineering | 2 | C | 15 |
| H63W | BEng Electronic Engineering | 2 | C | 15 |
| H63X | MEng Electronic Engineering | 2 | C | 15 |
| HH35 | BEng Systems Engineering | 2 | C | 15 |
| HH31 | MEng Systems Engineering | 2 | C | 15 |
| HH75 | BEng Manufacturing and Mechanical Engineering | 2 | C | 15 |
| HH76 | MEng Manufacturing and Mechanical Engineering | 2 | C | 15 |
| HN11 | BSc Engineering and Business Studies | 2 | C | 15 |
| HN15 | BEng Engineering Business Management | 2 | C | 15 |

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

1 (core subject)

**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 |

| Module Content and Teaching | |
|---|---|
| **Lectures** | 30 x 1 |
| **Seminars** | 0 |
| **Tutorials** | 0* |
| **Project Supervision** | 0 |
| **Demonstration** | 0 |
| **Practical Class/Workshops** | 3 x 3 hour laboratories<br>1 x 2 hr laboratory<br>2 x 1 hr lab brief / de-brief |
| **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 1 hour revision classes<br>105 hours guided independent learning.<br>*Student study clinics may be run in support of the module but these will not appear as a timetabled activity. |

| 18. Assessment Method (Standard) | | |
|---|---|---|
| **Type of assessment** | **Length** | **% weighting** |
| **Written Examinations** | 2 Hours | 60 |
| **Practical Examinations** | - | |
| **Assessed essays/coursework** | Laboratory based assessments | 2 x 20% |
| **18a. Final chronological assessment** *(please see guidance)* | Examination | |

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

- Exam advice class.
- Written feedback on laboratory report.
- Model solutions to past papers.
- Support through advice and feedback hours.
- Examples clinics.
- Cohort level feedback on examinations.

**20. Outline Syllabus**

The module is delivered in two parts: Dynamics and Fluid Mechanics. The topics covered are:

**Dynamics**

- The principles of work and energy (potential energy, conservative and non-conservative forces)
- Analysis of rigid-body motion: kinematics and kinetics.
- Analysis of standard mechanisms: slider-crank, four bar link.
- Deriving governing equations for general systems using energy methods.
- Step response and frequency response of second-order systems: oscillation, vibration and resonance.
- Supporting laboratory exercises.

**Fluid Mechanics**

- Viscosity: real and inviscid fluids
- Pressure and its measurement (manometers)
- Reynolds number: laminar and turbulent flow
- Conservation of mass and momentum (the continuity and momentum equations).
- Application of Bernoulli's equation
- Model testing, dimensional analysis, and drag coefficients
- Laminar and turbulent flows; pipe flows, surface roughness, Moody Chart.
- Compressibility effects.
- The role of pressure in fluid mechanics and the 1-D wave equation for an acoustic wave.
- Supporting laboratories in wind-tunnel measurement of flow around a cylinder, and internal flow in a converging/diverging pipe.

The above topics will be augmented with deeper teaching of the practical applications of mathematical methods. Methods used will include vector calculus, linear algebra, differential and partial differential equation solutions.

**21. Illustrative Bibliography**

**Recommended Options for Literature: Fluid Mechanics**

(1) Potter, M.C., Wiggert, D.C., Ramadan, B.H., 2017, Mechanics of Fluids (5th Edition), Cengage Learning, Stamford. ISBN 978-1-305-63761-0.
(2) White, F.M., 2016, Fluid Mechanics (8th Edition), McGraw-Hill, New York. ISBN 9789814720175.
(3) Douglas, J.F., Gasiorek, J.M., Swaffield, J.A., Jack, L.B., 2011, Fluid Mechanics (6th Edition, or latest edition whenever new editions become available), Prentice Hall, Pearson Education Limited, Harlow, UK.

**Recommended options for Literature : Dynamics and Vibration**

(1) F. Beer and E. Russell Johnston Jr., *Vector Mechanics for Engineers: Dynamics (2009).*
(2) R. C. Hibbeler, *Engineering Mechanics: Dynamics (2012).*
(3) A. M. Bedford, *Engineering Mechanics: Dynamics (2007).*

**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.** |
| n/a |

| Approval | |
|---|---|
| **24. Module leader's signature** | Professor Peter Thomas |
| **25. Date of approval** | 25 April 2018 |
| **26. Name of Approving Committee (include minute reference if applicable)** | School of Engineering and WMG Course and Module Approval Committee, Minute 245-17/18 |
| **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** |
| 60% | 2 x 20% Laboratory Report | 2 hrs |
| **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)?** | **January** | |
| **A6. Is reading time required?** | ☐ Yes | ☒ No |
| **A7. Please specify any special exam timetable arrangements.** | | |
| n/a | | |
| **A8. Stationery requirements** | | |
| **No. of Answer books?** | 2 | |
| **Graph paper?** | Y | |
| **Calculator?** | Y | |
| **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 |
| **Restricted?** | ☐ Yes | ☒ No |
| **If restricted, please provide a list of permitted texts:** | n/a | |

| 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 15)** | **Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 16)** |
| 1) Show a developed ability in the analysis of rigid body planar motion. Understand that forces maybe either conservative or non-conservative and appreciate how these apply in modelling real-world applications. | Lectures | Examination |
| 2) Employ the principles of work and energy as a means to generate governing equations and evaluate system response. | Lectures | Examination |
| 3) Perform kinematic and kinetic analysis of rigid bodies employing vector methods and graphical solutions as appropriate. | Lectures; Laboratory (dynamics) | Examination, Laboratory Report |
| 4) Demonstrate knowledge and understanding of the rudimentary equations of fluid mechanics and be able to classify different types of flow regime and fluid behaviour using appropriate dimensionless numbers. | Lectures, Laboratory (Pipe flow), Laboratory (Wind-tunnel cylinder), | Examination, Laboratory Report |
| 5). Apply Bernoulli's principle to a range of applications to predict inviscid fluid-flow behaviour, while being able to identify its limitations. Show appreciation for extensions to fluid mechanics theory, e.g. compressibility, surface tension. | Lectures | Examination |
| 6) Analyse experimental measurements of velocity and pressure, and be able to quantify and analyse the various forms of error. | Laboratory (Pipe flow), Laboratory (Wind-tunnel cylinder) | Examination, Laboratory Report |