**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** | 02/10/2018 |
| **If new, does this module replace another? If so, enter module code and title:** | |
| **If revised/discontinued, please outline the rationale for the changes:** | More labs and tutorial sessions based on student feedback. Change of Module Leader. |
| **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)** | ES4D8 |
| **2. Module Title** | Advanced Geotechnical Engineering |
| **3a. Lead department:** | School of Engineering |
| **3b. Teaching Split (if known):** | 100% School of Engineering |
| **4. Name of module leader** | Dr Gary Fowmes |
| **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 deepen knowledge and understanding across advanced topics in geotechnical engineering. To instil an appreciation of the principles, theories and concepts related to Tunnelling and Underground Space, Legislation & Planning about Contaminated Ground, Risk assessment for Contaminated Land and Groundwater, Ground improvement techniques. |

| Approval information | |
|---|---|
| | The students will be given the opportunity in the field work to carry out practical activities related to geological controls on instability. |
| **8. Principal Learning Outcomes** | By the end of the module the student should be able to:<br>• Demonstrate advanced understanding of how to manage ground engineering problems<br>• Apply and evaluate the techniques currently available for ground improvement and specify techniques for different site conditions.<br>• Critically evaluate design methods for the treatment and containment of waste and the types of problems which may arise in the development of difficult, derelict and contaminated land.<br>• Synthesise geotechnical and other data and apply it to the design of underground openings. |
| **9. Timetabled Teaching Activities (summary)** | 19 x 1 hrs lectures, 4 hrs of tutorials, 4 hrs of labs, 3 x 1hr revision classes and 3 days x 8 hours of residential field course.<br>**Total of 54 hours.** |
| **10. Departmental Web-link** | www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es4d8 |
| **11. Other essential notes** | Advice and feedback hours are available for answering questions on the lecture material (theory and examples). |
| **12. Assessment methods (summary)** | 100% examination (3 hrs). |

**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.**

School of Engineering (100%).

**14. Availability of module**

| Degree Code | Title | Study Year | C/OC/ A/B/C | Credits |
|---|---|---|---|---|
| H211 | MEng Civil Engineering (and variants) | 4 | A | 15 |
| H212 | MEng Civil Engineering with Intercalated Year | 5 | A | 15 |
| H213 | MEng Civil Engineering with a Year in Research | 5 | A | 15 |
| H21A | MEng Civil Engineering with Exchange Year | 4 | A | 15 |
| H107 | MEng Engineering (and variants) | 4 | A | 15 |
| H109 | MEng Engineering with Intercalated Year | 5 | A | 15 |
| H110 | MEng Engineering with a Year in Research | 5 | A | 15 |
| New | MEng Engineering with Exchange Year | 4 | A | 15 |

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

10

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

Pre-requisite ES3B6 Geotechnical Engineering.

## Module Content and Teaching

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

| | |
|---|---|
| **Module duration (weeks)** | 19 |
| **Lectures** | 5 x 2hrs (Term 1) and 9 x 1 Hrs (Term 2) = 19 hours total |
| **Seminars** | None |
| **Tutorials** | 2 x 2 hrs (1 term 1, 1 term 3) = 4 hours |
| **Project Supervision** | None |
| **Demonstration** | None |
| **Practical Class/Workshops** | 2 x 2 hrs (term 1, or early term 2) = 4 hours |
| **Supervised time in studio/workshop** | None |
| **Fieldwork** | 3 days x 8 hours = 24 hours |
| **External visits** | None |
| **Work based learning** | None |
| **Placement** | None |
| **Year abroad** | None |
| **Other activity** | • 3 x 1hours revision classes<br>• 96 hours of guided independent learning |

| Module Content and Teaching | | |
|---|---|---|
| *(please describe): e.g. distance-learning, intensive weekend teaching etc.* | | |
| **18. Assessment Method (Standard)** | | |
| **Type of assessment** | **Length** | **% weighting** |
| **Written Examinations** | 3 Hours | 100 |
| **Practical Examinations** | | |
| **Assessed essays/coursework** | | |
| **18a. Final chronological assessment** *(please see guidance*) | Written Examination. | |

| **19. Methods for providing feedback on assessment.** |
|---|
| Cohort level feedback on the written exam. |
| **20. Outline Syllabus** |
| **Problem Ground Improvement techniques**: Overview of problem ground conditions, giving details and case studies on the following: Shrinking and swelling clays, peat and glacial tills. The students are introduced to difficult sites through problem based learning using real world data and drawings. Ground improvement techniques covered include replacement, dynamic and vibro compaction, use of admixtures and the use of geosynthetic. Geosynthetics reinforced soil is demonstrated in a laboratory wall building session.<br><br>**Introduction to Tunnelling**: Methods of tunnelling and support. Design using rock classification systems such as Q and RMR. Prediction of subsidence. Modelling of discontinuity defined failures in roof and walls of underground excavations. Practical laboratory demonstrations of rock bolting will also be given.<br><br>**Contaminated Ground**: Concepts. Legislation & planning advice in the UK. Risk assessment for contaminated land and groundwater: Source-pathway-target framework.<br>Site & ground investigation and sampling/analysis, conceptual modelling, risk detection. Characteristics and sources of contaminated land and groundwater pollution, pollutant properties. Porous media transport, diffusion and dispersion and reactions. Governing equations including sources and sinks, adsorption and desorption. Mathematical models and concepts including retardation coefficients and the effect of organic matter, analytical and numerical Modelling approaches. Covering systems, pump & treat technology, in-situ air-sparging.<br><br>**Field Course** (3 days): To the Isle of Wight, to inspect and map examples of land instability in the Ventnor Undercliff area (the largest urban landslide complex in Europe) and elsewhere. Geological controls on instability. Assessment of hazard and risk. |

**21. Illustrative Bibliography**

Ratan,T. Civil excavations and tunnelling– a practical guide, 2005.
Hemphill, G.B., Practical tunnel construction, 2012.
Maidl, B., Schmid, L., Ritz, W., Herrenknecht, M., Sturge, D.S., Hardrock Tunnel Boring Machnies, 2008.
Nathanail, P.C. Reclamation Of Contaminated Land, 2004.
Todd D.K., and Mays L.W., Groundwater hydrology, 2008.
Zheng C. and Bennett G.D, Applied Contaminant Transport Modeling, 2002.
Ward A.D., Trimble S.W., Burckhard S.R., Lyon J.G., Environmental Hydrology, 2015.

**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** | Dr Gary Fowmes |
| **25. Date of approval** | 21 March 2018 |
| **26. Name of Approving Committee (include minute reference if applicable)** | School of Engineering and WMG Course and Module Approval Committee (CMAC) Minute 202-17/18 |
| **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** |
| 100 | | 3 hours |
| **A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.** | | |
| N/A | | |
| **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.** | | |
| N/A | | |
| **A8. Stationery requirements** | | |
| **No. of Answer books?** | 1 | |
| **Graph paper?** | Yes | |
| **Calculator?** | Yes | |
| **Any other special stationery requirements (e.g. Data books, tables etc)?** | | |
| **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 17)** | **Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)** |
| Demonstrate advanced understanding of how to manage ground engineering problems | Lectures, Laboratory, Tutorials | Written examination |
| Apply and evaluate the techniques currently available for ground improvement and specify techniques for different site conditions. | Lectures, Field work | Written examination |
| Critically evaluate design methods for the treatment and containment of waste and the types of problems which may arise in the development of difficult, derelict and contaminated land. | Lectures | Written examination |
| Synthesise geotechnical and other data and apply it to the design of underground openings. | Lectures, Tutorials, Laboratory | Written examination |