UNIVERSITY OF WARWICK

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

Approval information	
Approval Type	☐ New module ☒ Revised module ☐ 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:	Periodic review of module and course content, it being 7 years since it was first introduced. Nomination of ES94W as a pre-requisite module due to certain topics (stereographic projections) being introduced there. Introduction of an assessed practical exercise (20%) to improve student skills development. Introduction of a revision tutorial.
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)	ES95C
2. Module Title	Rock Mechanics
3a. Lead department:	School of Engineering (100%)
3b. Teaching Split (if known):	100% Engineering
4. Name of module leader	Dr Gary Fowmes
5. Level	UG: ☐ Level 4 (Certificate) ☐ Level 5 (Intermediate) ☐ Level 6 (Honours) PG: ☒ Level 7 (Masters) ☐ Level 8 (Doctoral) See Guidance Notes for relationship to years of study
6. Credit value(s) (CATS)	15
7. Principal Module Aims	To provide a theoretical and empirical framework for understanding and predicting the behaviour of rock around

Module Summary	
	excavations and under foundations associated with tunnelling projects.
8. Principal Learning Outcomes	By the end of the module students should be able to: • Apply knowledge of rock mechanics to a range of rock engineering problems associated with tunnels and underground excavations. • Predict the behaviour of the rock mass in response to excavation. • Interpret rock mass classification data to formulate support strategies.
9. Timetabled Teaching Activities (summary)	Lectures 30 hrs, Laboratory 2 hr, Practical 2 hr, Revision Class 2 hr **Total 36 hours.**
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es95c/
11. Other essential notes	The module is taught in a five-day intensive block (excluding Wednesday afternoon). Pre reading is required before the module. Advice and feedback hours are available for answering questions on the lecture material. The module is available as a standalone CPD course for external attendees.
12. Assessment methods (summary)	3 hour Written Examination 80% 2 hour Practical Test 20%

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
H214	Tunnelling and Underground Space FT	M1	C	15
H214	Tunnelling and Underground Space PT	M1	OC	15
H214	Tunnelling and Underground Space PT	M2	OC	15

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

1

16. Pre- and Post-Requisite Modules

Pre: ES94W Geological Investigation and Ground Characterisation

Module Content and Teaching

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

Module duration (weeks)	1
Lectures	30
Seminars	
Tutorials	2
Project Supervision	
Demonstration	
Practical Class/Workshops	4
Supervised time in studio/workshop	
Fieldwork	
External visits	
Work based learning	
Placement	
Year abroad	
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	114 hours of guided independent learning

Module Content and Teaching

18. Assessment Method (Standard)

Type of assessment	Length	% weighting
Written Examinations	3 Hours	80%
Practical Test	2 Hours	20%
Assessed essays/coursework		
18a. Final chronological assessment *(please see guidance*)	Examination	

19. Methods for providing feedback on assessment.

Practical Test: Individual written feedback.
Examination: publication of recent past examination papers and model solutions or mock paper and solutions where past papers do not exist. Cohort level feedback on examinations.

20. Outline Syllabus

- Behaviour of jointed rock mass (structure): Shear behaviour of discontinuities. Shear testing techniques. Compressibility of rock masses. *In situ* testing of rocks.
- Rock excavation design and assessment: Behaviour of rock around underground openings: ground condition, index properties, *in situ* measurement of stress and strain, elastic and elasto-plastic behaviour, rock bursts and stress problems, effects of groundwater.
- Rock mass classification systems and Rock Engineering System (RES).
- Use of stereographic techniques for underground excavation modelling.
- Design and use of rock bolts as support for underground excavation.
- Industrial case studies.

21. Illustrative Bibliography

- Feng, X-T. Rock Mechanics and Engineering, CRC Press, 5 volumes, pp. 3796, 2017 (ISBN 9781138027640)
- Hoek, E., 2007. Practical Rock Engineering, published free online at: www.rocscience.com/hoek/corner/Practical_Rock_Engineering.pdf
- Hudson, J.A. & Harrison, J.P., Engineering Rock Mechanics: An Introduction to the Principles, Elsevier Science, pp.456, 1997 & 2005 (ISBN 0080438644) QC 137.8.H8 (also available as e-book)
- Hudson, J.A. & Harrison, J.P., Engineering Rock Mechanics: Part 2: Illustrative Worked Examples, Elsevier Science, pp.506, 2000 (ISBN 0080430104) (available as e-book)
- Priest, S.D., Hemispherical Projection Methods in Rock Mechanics, London: Allen & Unwin, pp.124, 1985. (ISBN 0046220070) QC 137.8.P7
- Wyllie, D.C., Foundations on Rock, New York: E & FN Spon, 2nd ed., pp.401, 1999. (ISBN 0419232109) TA775.W95

In addition students are provided with an extensive list of relevant papers principally drawn from

the following journals and updated annually:

- Engineering Geology
- International Journal of Rock Mechanics & Mining Science
- Rock Mechanics and Rock Engineering
- Tunnelling and Underground Space Technology

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	25 April 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee (CMAC), Minute 264-17/18
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**
80	**20% Practical Test**	**3 hr**
A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.		
no		
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)?	**May**	
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?	**Y**	
Calculator?	**Y**	
Any other special stationery requirements (e.g. Data books, tables etc)?	**Rock Mechanics Data Sheet**	
A9. Type of examination paper		
Seen?	☐ Yes	☒ No
Open Book?	☐ Yes	☒ No
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)**
Apply knowledge of rock mechanics to a range of rock engineering problems associated with tunnels and underground excavations.	Lectures, examples sheets	Written Examination
Predict the behaviour of the rock mass in response to excavation.	Lectures, practical class	Written Examination, Practical Test
Interpret rock mass classification data to formulate support strategies.	Lectures, examples sheets	Written Examination