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:	Entirely new optional module aiming to provide the knowledge base for students targeting on a 3rd year project in the field of reaction and materials engineering
If revised/discontinued, please outline the rationale for the changes:	N/A
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)	ES2E4
2. Module Title	Reaction Engineering Principles
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% School of Engineering
4. Name of module leader	Professor Andre van Veen
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 credits
7. Principal Module Aims	• Introduce concepts in chemical reaction engineering in view of application to chemical process technology. • Develop a firm understanding of the principles of stoichiometric (mass balance), chemical thermodynamics and kinetic (rate expressions) considerations as prerequisite for mathematical description of chemical conversion and process integrated reactor

Module Summary	
	design. • This module also equips students with the fundamental skills required to perform a 3rd year individual project in the field of chemical engineering.
8. Principal Learning Outcomes	By the end of the module the student should be able to... • confidently identify appropriate rate expressions in chemical kinetics based on stoichiometry and reaction network type. • perform a quantitative description of adsorption and desorption processes • compare and contrast the concepts of micro and macro kinetics. • recognize the impact of the residence time distribution on reactor performance and choose appropriate models for given real-life reactor problems. • specify the system of differential equations allowing the mathematical description of a reaction network. • have a strategic vision on constraints in chemical reactor design. • evaluate simplifications in models applied for reactor layout (design) which may cause imperfections in predictions.
9. Timetabled Teaching Activities (summary)	30 x 1 hour lectures 2 x 1 hour Example classes 1 x 1 hour Revision class 1 x 1 hour Multiple choice test 1 x 1 hour Laboratory briefing seminar 1 x 4 hour Laboratory experiment Total: 39 hours
10. Departmental Web-link	https://warwick.ac.uk/fac/sci/eng/eso/modules/year2/
11. Other essential notes	This module is prerequisite for students seeking to carry out 3rd year projects in the field of reaction and materials engineering Advice and feedback hours are available for answering questions on the lecture material (theory and examples).
12. Assessment methods (summary)	80% written examination (3 hours); 10% laboratory assignment (up to 10 pages); 10% multiple choice test prior to examination.

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

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H113	BEng Engineering	2	A/B	15
H114	MEng Engineering	2	A/B	15
H315	BEng Mechanical Engineering	2	A	15
H316	MEng Mechanical Engineering	2	A	15

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

Minimum 15, maximum 30

16. Pre- and Post-Requisite Modules

Awareness of chemistry at A-level standard would be an advantage if choosing this option

Module Content and Teaching

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

Module duration (weeks)	**10**
Lectures	**30**
Seminars	**1 (Laboratory briefing)**
Tutorials	**None**
Project Supervision	**None**
Demonstration	None
Practical Class/Workshops	Laboratory exercise (1 x 4 hours = 4 hours) (Requires further pre-laboratory and report preparation.)
Supervised time in studio/workshop	None
Fieldwork	None
External visits	None
Work based learning	None
Placement	**None**
Year abroad	**None**
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	**2 hours Example classes (2 x 1 hour)** **1 hour Multiple choice test** **1 hour Revision class**

Module Content and Teaching

	111 hours Guided independent learning	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	**80%**
Practical Examinations	None	
Assessed essays/coursework	Laboratory assignment report (limited to 10 pages). 1 hour Multiple choice test.	**10%** **10%**
18a. Final chronological assessment *(please see guidance*)	Written Examination (80%)	

19. Methods for providing feedback on assessment.

Support through advice and feedback hours.
Written feedback on marked laboratory assignment.
Cohort-level feedback on multiple choices test.
Cohort-level feedback on final exam.

20. Outline Syllabus

Formalisms in the mathematical description of a chemical reaction
Chemical kinetics of homogeneous and heterogeneous reactions (catalysis) - Micro kinetics
(Quantitative) description of adsorption phenomena
Mass transport in a solid matrix - Macro kinetics
Impact of residence time distribution on reactor performance
Ideal reactor models and simplified design of reaction devices

21. Illustrative Bibliography

O. Levenspiel, "Chemical reaction engineering 3rd edition", John Wiley & Sons Inc. (1999)
J.M. Thomas, W.J. Thomas, "Principles and practice of heterogeneous catalysis", VCH (1997)

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.

Equipment for the laboratory experiment is provided by the chemical engineering group

Resources
scheduling required time slots on the specialist facility (N_2 physisorption device - BET analysis facility). Availability of equipment is ensured by proper servicing and timely booking of access. Lecture facilities will be provided via the standard channels.

Approval	
24. Module leader's signature	Professor Andre van Veen
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 249-17/18
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%	**10% 1 hr multiple choice test 10% laboratory assignment (up to 10 pages)**	**3hr**
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?	**yes**	
Calculator?	**yes**	
Any other special stationery requirements (e.g. Data books, tables etc)?	**Datasheet on key relations attached to the paper**	
A9. Type of examination paper		
Seen?	☐ Yes	☒ No
Open Book?	☐ Yes	☒ No
Restricted?	☐ Yes	☒ No

Examination Information	
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)**
Confidently identify appropriate rate expressions in chemical kinetics based on stoichiometry and reaction network type.	Lectures.	Examination and Multiple choice Test.
Perform a quantitative description of adsorption and desorption phenomena.	Lectures, laboratory exercise.	Examination, Laboratory report and Multiple choice Test.
Compare and contrast the concepts of micro and macro kinetics.	Lectures.	Examination and Multiple choice Test.
Recognize the impact of the residence time distribution on reactor performance and choose appropriate models for given real-life reactor problems.	Lectures.	Examination and Multiple choice Test.
Specify the system of differential equations allowing the mathematical description of a reaction network.	Lectures.	Examination and Multiple choice Test.
Have a strategic vision on constraints in chemical reactor design.	Lectures.	Examination and Multiple choice Test.
Evaluate simplifications in models applied for reactor layout (design), which may cause imperfection in predictions.	Lectures.	Examination and Multiple choice Test.