MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME514 ADVANCED TOPICS IN FLUID SYSTEMS ENGINEERING

Module Registrar: Dr Konstantinos Zografos k.zografos@strath.ac.uk	**Taught To (Course): Cohorts for whom class is optional**	
Other Lecturers Involved: Dr Paolo Capobianchi	**Credit Weighting: 10 (ECTS 5)**	**Semester: 2**
Optional class	**Academic Level: 5**	**Suitable for Exchange: Y**

Required prerequisites

Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

Fundamental knowledge:

- Prior knowledge of basic principles and concepts of fluid Mechanics.
- Knowledge of partial derivatives, partial differential equations and differential relations of fluid flow (i.e., continuity equation, momentum equation etc.).
- Linear algebra, vectors, matrices.

Basic skills:
- Ability to research a given engineering subject and to work collaboratively in order to present it

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
20			20					60	100

Educational Aim

Rheology is responsible for the study of the deformation and the flow of matter. This scientific field is focussing on the study of the flow behaviour of complex fluids such as polymers, biological fluid systems, pastes, foods and other compounds, which are of great importance for a wide range of engineering applications. These fluids are commonly referred as non-Newtonian and when flowing their behaviour significantly deviates from the simple and well-reported Newtonian fluid response. The aim of this class is to introduce the basic ideas and principles of the field of Rheology and the various complex systems examined within, while also to present the existing procedures and methods that are typically employed to study these fluids. Additional topics that are closely related to Rheology will be delivered by other lecturers involved aiming to expand the knowledge around advanced engineering topics.

Learning Outcomes

On completion of the module the student is expected to be able to:

LO1 Understand the importance of the field of Rheology and its significance for investigating the flows of non-Newtonian fluids for a range of existing applications

LO2 Recognise and classify the basic observed behaviours of non-Newtonian fluids and compare with the equivalent of Newtonian fluids

LO3 Recognise the different types of constitutive equations that are used to model non-Newtonian complex behaviours based on the continuum approach

LO4 Be able to do high level scientific discussions

Syllabus

The module will teach the following:

An introduction to the wide range of different behaviours that are observed in non-Newtonian fluid flows and what the field of Rheology investigates. Vectors will be reminded and the importance of using tensors will be discussed focussing on the importance of the Einstein notation. Constitutive relationships that are employed to best describe the flow of non-Newtonian fluids. Definitions and importance of new dimensionless numbers that exist in order to characterise the flow of complex fluids and how to present data in appropriate formats. Different existing techniques and methods that are considered in order to investigate and study these fluids. How to use tools such as computational fluid dynamics (CFD) and experimental set-ups to investigate complex fluids in the context of computational Rheology. Explain phenomena and underlying mechanisms of closely related engineering topics.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1: Understand the importance of the the field of Rheology and its significance for investigating the flows of non-Newtonian fluids for a range of existing applications
C1: To recognise the role of Rheology and identify applications that are benefited by this scientific field

LO2: Recognise and classify the basic observed behaviours of non-Newtonian fluids and to compare with the equivalent of Newtonian fluids
C1: Adequately explain the different types of shear-dependent and extensional viscosities.
C2: Be able to draw the viscosity vs shear-rate diagrams and compare with Newtonian fluid responses.
C3: Understand and explain the significance of the appropriate dimensionless numbers.

LO3: Recognise the different types of constitutive equations that are used in order to model non-Newtonian complex behaviours based on the continuum approach
C1: Being able to recognise the different models, the meaning of their parameters and the introduced physics.
C2: To be able to perform evaluations and discussions of rheological properties when considering standard viscometric flows.

LO4: Be able to do high level scientific discussions
C1: Able to explain the basic principles and ideas around an agreed topic
C2: Illustrate the ability to exchange knowledge obtained

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

This module is designed to introduce to students the scientific field of Rheology and illustrate its importance and its applications in engineering. The assessment will be through a coursework and a final invigilated online exam. The former will be in the form of group presentations to encourage collaborative understanding, knowledge exchange and initiate discussions around challenging topics that will enhance learning. The latter will assess the level of individual understanding around the material taught. The major means of feedback will be through class discussion. Assessment and feedback in this course can also be incorporated in discussions in class. Informal feedback such as one-to-one discussion may be arranged if necessary.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Apr/May	1 hr	60%	1	40%				
* LO1-4				* LO1-4		*		*	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submission deadlines (*academic weeks*):
Group presentations will be given in week 7 counting towards 40% of the final mark.
An invigilated on-line assessment exam will be given in the semester 2 diet counting towards 60% of the final mark.

Resit Assessment Procedures:
2hr examination in August diet.

PLEASE NOTE:
Students must gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-assessed during the August diet. This re-assessment will consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference**

** "Understanding Rheology" by F. A. Morrison, Oxford University Press
* "Computational Rheology" by R. G. Owens and T. N. Phillips, Imperial College Press
* “Dynamics of Polymeric Liquids, vol. 1” by R. B. Bird, R. C. Armstrong and O. Hassager, Wiley, 1987

Online access Myplace for class notes.

Further class reading to be recommended by the individual lecturer invited to discuss a particular topic.

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Date	Time	Room No
By student request only: Dr K. Zografos to arrange (additional feedback - on exam or homework - will be provided on request).	Email to arrange	JW808g

Session: 2021/22

Approved:

Course Director Signature: Dr E Henderson

Date of Last Modifications: 20/09/2021

(form Updated June 2021-MAE)

MODULE TIMETABLE

Module Code:	**ME514**	**Module Title:**	**Advanced Topics in Fluid Systems Engineering**

Brief Description of Assessment:

Group presentation and exam. We will assess whether a student can:
- Understand the basic ideas of Rheology and the principles describing the complex systems introduced.
- Be involved into high level scientific discussions around a provided subject and illustrate ability to deliver high level presentation of a subject.
- Identify different behaviours of non-Newtonian fluid flows and complex systems.
- Illustrate an understanding of the underlying physics.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment. Dropdowns may be left blank. Add extra notes below the dropdowns where relevant.

Please note: Timings can and will change, this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Project Set	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Presentation	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam