MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME526 ENGINEERING PLASTICITY

Module Registrar: Prof Donald Mackenzie d.mackenzie@strath.ac.uk	**Taught To (Course): Cohorts for whom class is optional**	
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 1**
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.

Elastic-Plastic Deformation of Metals:
Yield, strain hardening, ductile rupture, unloading & reloading

Elastic-Plastic Analysis of 2-Bar Structures:
Plasticity material models, strain hardening analysis, limit analysis, residual stress.

Mathematical methods:
Linear algebra, vectors & matrices.

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
20	10							70	100

Educational Aim

This module aims to introduce concepts in Engineering Plasticity in metals and their application to problems in Engineering Design and Structural Integrity Assessment. The course will introduce students to basic concepts in plastic deformation, including local and structural failure mechanisms, through one-dimensional analysis models. These will then be expanded to three dimensions, introducing stress and strain tensors and multiaxial yield criteria. Students will gain insight into the elastic plastic response and failure of metallic structures through analysis of generic engineering components amenable to analytical solution, including beams, bars, cylinders and spheres.

Learning Outcomes

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

LO1 Understand the elastic-plastic deformation of metal structures and associated structural failure mechanisms

LO2 Perform analytical evaluation of the elastic plastic deformation of generic engineering components and understand the significance of material model selection on analysis outcomes

LO3 Appreciate the significance of elastic-plastic deformation in engineering design by analysis and structural integrity assessment

Syllabus

The module will teach the following:

Elastic and Plastic Deformation of Metals; Uniaxial Stress & Strain; 1D Elastic-Plastic Analysis and Material Models; Elastic-Plastic Beam Bending, Shakedown & Ratcheting; 3D Stress and Strain; Multiaxial Yield Criteria; Elastic Plastic Deformation of Hollow Spheres; Elastic Plastic Deformation of Hollow Cylinders; Autofrettage; Design Codes & Standards.

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 nature of elastic-plastic deformation and be able to develop analytical models for simple geometries and boundary conditions
C1 Understand the mechanism of plastic deformation
C2 Understand the role of yield criteria in determining the elastic limit under multiaxial stress
C3 Understand how stress redistributes in metal structures loaded beyond yield

LO2 Demonstrate the ability to apply and solve governing equations for specific applications
C1 Able to select an appropriate material model
C2 The ability to identify appropriate failure criteria for different structural configurations
C3 The ability to define the structural problem mathematically and solve the resulting analytical models

LO3 Appreciates the role of elastic-plastic analysis in engineering practice
C1 Awareness of alternative design and assessment approaches
C2 Familiar with the requirements for inelastic analysis in design and assessment Codes and Standards

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/)

Assessment is by one 2 hour exam, December diet.
Feedback will be provided at weekly tutorial sessions through discussion with individuals and/or groups.

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	Dec	2 hours	100%						
*LO1,LO2,LO3						*		*	

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

Coursework / Submissions deadlines (*academic weeks*):

Resit Assessment Procedures:
2hr examination in July/August diet

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

Recommended Reading

The following books are recommended reading but purchase is not essential.

J. Chakrabarty, Theory of Plasticity, Butterworth-Heinemann
D.W.A Rees, Basic Engineering Plasticity, Butterworth-Heinemann
R. Hill, The mathematical theory of plasticity, Oxford Science Publications
J. Lubliner, Plasticity Theory, Dover
N.E. Dowling, Mechanical Behaviour of Materials, Pearson

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

Date	Time	Room No
		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr A McLaren
Date of Last Modifications: 23/08/2024

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME526**	**Module Title:**	**Engineering Plasticity**

Brief Description of Assessment:

One 2-hour examination, 100% of the final mark.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; 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
	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.	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.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam

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