DISCLAIMER

The College has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The College reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules.

You are advised to contact the College directly if you require further information.

The 2017/18 academic year begins on 25 September 2017

DATES OF 2017/18 TERMS

25 September 2017 – 15 December 2017
08 January 2018 – 23 March 2018
16 April 2018 – 15 June 2018

SEMESTER 1

25 September 2017 – 26 January 2018

SEMESTER 2

29 January 2018 – 15 June 2018
WELCOME

We would like to extend a very warm welcome to all students for the 2017/18 academic year and in particular, to those joining the College for the first time.

The University offers an enviable range of facilities and resources to enable you to pursue your chosen course of study whilst enjoying university life. In particular, the College of Engineering offers you an environment where you can develop and extend your knowledge, skills and abilities. The College has excellent facilities, offering extensive laboratory, workshop and IT equipment and support. The staff in the College, many of whom are world experts in their areas of interest, are involved in many exciting projects, often in collaboration with industry. The College has excellent links with industry, with many companies kindly contributing to the College’s activities through guest lectures and student projects. We have close links with professional engineering bodies and this ensures that our courses are in tune with current thinking and meet the requirements of graduate employers. All the staff are keen to provide a supportive environment for our students and we hope that you will take full advantage of your opportunities and time at Swansea.

We hope that you will enjoy the next academic session and wish you every success.

Professor Stephen GR Brown  
**Head of the College of Engineering**

Professor Cris Arnold  
**Deputy Head of College and**  
**Director of Learning and Teaching**

Professor Johann Sienz  
**Deputy Head of College and**  
**Director of Innovation and Engagement**

Professor Dave Worsley  
**Deputy Head of College and**  
**Director of Research**

CIVIL ENGINEERING PORTFOLIO DIRECTOR:  
Professor E De Souza Neto ([e.deSouzaNeto@swansea.ac.uk](mailto:e.deSouzaNeto@swansea.ac.uk))  
Room A134, Engineering Central

YEAR 4 CO-ORDINATOR:  
Professor CF Li ([c.f.li@swansea.ac.uk](mailto:c.f.li@swansea.ac.uk))  
Room 108, ESRI Building

ADMINISTRATIVE OFFICER:  
Should you require **administrative support** please visit the Engineering Reception, open Monday – Friday 8:30am – 5:00pm and speak with a member of the Student Information Team who will be happy to help.
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<td>Finite Element Computational Analysis</td>
<td>Flood Risk Management</td>
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<td>CORE</td>
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Total 120 Credits
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<tr>
<th>EG-M23 Finite Element Computational Analysis</th>
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<tbody>
<tr>
<td><strong>Credits:</strong> 10 Session: 2017/18 Semester 1 (Sep-Jan Taught)</td>
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<tr>
<td><strong>Module Aims:</strong> This module introduces the fundamentals of the Finite Element Method to enable the student to use it in the solution of a range of problems of engineering interest. The classes of engineering problems covered in this module include elastic analysis of structures, heat conduction problems, seepage flow through soils and ideal fluid flow. In this context, MATLAB sample programs will be provided to illustrate the structure of a finite element software capable of solving these classes of problems.</td>
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<td><strong>Pre-requisite Modules:</strong> EG-323</td>
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<td><strong>Incompatible Modules:</strong></td>
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<td><strong>Format:</strong></td>
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<tr>
<td>Lectures 2h per week</td>
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<td>Example Classes 1h per week</td>
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<td>Directed private study 3h per week</td>
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<td><strong>Lecturer(s):</strong> Dr R Sevilla</td>
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<td><strong>Assessment:</strong> Examination 1 (60%)</td>
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<tr>
<td>Assignment 1 (40%)</td>
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<tr>
<td><strong>Assessment Description:</strong> Examination (60% of the module marks)</td>
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<tr>
<td>Standard university examination (open book).</td>
</tr>
<tr>
<td>- Assignment (40% of the module marks)</td>
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<tr>
<td>Group assignment where students are required to choose one of the following options:</td>
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<tr>
<td>1. Create a finite element model using commercial software to solve a realistic engineering problem in solid or fluid mechanics.</td>
</tr>
<tr>
<td>2. Modify an existing MATLAB program to solve an engineering problem using finite elements.</td>
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<tr>
<td>(*) Option 1 will require students to independently learn how to use the commercial software ANSYS.</td>
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<tr>
<td>To support this task, students will have access to</td>
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<tr>
<td>- online resources</td>
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<tr>
<td>- support from the Math and CAE Cafe offered by the College of Engineering.</td>
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<tr>
<td><strong>Moderation approach to main assessment:</strong> Universal second marking as check or audit</td>
</tr>
<tr>
<td><strong>Failure Redemption:</strong> Exam re-sits according to University regulations. A supplementary exam will form 100% of the module marks.</td>
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<tr>
<td><strong>Assessment Feedback:</strong> Examination - Standard university exam feedback form.</td>
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<td>Assignment - Comments on submitted work will be sent to the groups.</td>
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<tr>
<td><strong>Module Content:</strong> Introduction to the Finite Element Method</td>
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<tr>
<td>- Isoparametric finite elements.</td>
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<td>- High-order finite elements.</td>
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<tr>
<td>- Numerical integration. Gaussian quadratures.</td>
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<tr>
<td>- Seepage flow</td>
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<tr>
<td>- Irrotational flow.</td>
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<tr>
<td>- 2D and axisymmetric elasticity.</td>
</tr>
<tr>
<td>- 3D elasticity.</td>
</tr>
<tr>
<td>- Error analysis.</td>
</tr>
<tr>
<td><strong>Intended Learning Outcomes:</strong> Upon completion of this module students should be able to:</td>
</tr>
<tr>
<td>- Use the weighted residual method to solve an engineering problem governed by partial differential equations.</td>
</tr>
<tr>
<td>- Convert a realistic elasticity, heat conduction, seepage flow and ideal fluid flow engineering problems into finite element models</td>
</tr>
<tr>
<td>- Solve simple elasticity, heat transfer, seepage flow and ideal fluid flow problems by hand using the finite element method.</td>
</tr>
<tr>
<td>- Use a computer program to set up and produce finite elementsolutions of simple engineering problems.</td>
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<tr>
<td>- Analyse/assess the output of finite element simulations.</td>
</tr>
<tr>
<td>- Produce simple finite element related code in MATLAB computer language.</td>
</tr>
<tr>
<td>- Use a commercial finite element software to perform a finite element simulation.</td>
</tr>
</tbody>
</table>
**Reading List:**

**Additional Notes:**
Penalty for late submission of continual assessment assignment: No marks awarded for late submissions.

Available to visiting and exchange students.

This module requires a prior knowledge of:
1. Basic Finite Elements - more specifically, knowledge of the content of the module EG-323 is assumed.
2. Computer programming - more specifically, MATLAB programming language - at a fairly basic level.
EG-M24 Advanced Structural Design

<table>
<thead>
<tr>
<th>Credits: 10</th>
<th>Session: 2017/18 Semester 1 (Sep-Jan Taught)</th>
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</thead>
</table>

**Module Aims:** This module aims to equip students with advanced structural design concepts from first principles, such as yield line theory, prestressed beams, combined torsion, bending and shear, strut and tie, composite sections, fire engineering. Design of sustainability and its applications will be taught. The module is taught in accordance with structural Eurocodes.

**Pre-requisite Modules:** EG-222; EG-225; EG-328

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures 20 hours. Example classes 10 hours. Directed private study 30 hours.

**Lecturer(s):** Miss X Yin

**Assessment:** Examination 1 (80%), Assignment 1 (10%), Assignment 2 (10%)

**Assessment Description:** Assessment: 20% of marks from the assigned design project work. Remaining 80% of the module marks are obtained by means of a 2-hour end of teaching block Closed Book examination. This module operates on a zero tolerance policy for late submission/plagiarism/collusion/commissioning of coursework i.e. zero marks awarded.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** Exam re-sits according to university regulations. A supplementary examination will form 100% of the module mark.

**Assessment Feedback:** Individual oral or written feedback will be given on coursework, prior to the January examination. Examination feedback will be provided via the College of Engineering online feedback system, reflecting on the class performance as a whole to individual exam questions.

**Module Content:**

Concrete Design to BS EN 1992
- Prestressed concrete beams design [3]
- Plastic analysis and design of reinforced concrete slabs, yield line theory and finite element method for analysis of slab[3]
- Design of torsion with combination of shear in reinforced concrete structures [2]
- Strut and tie analysis [2]

Steel Design to BS EN 1993, 1994
- Structural analysis of steelwork - global analysis, P-delta effect, imperfection [2]
- Connections - haunch connection design and in-plane moment connection [2]
- Fire engineering - fire resistance of steel structures [1]

Sustainable design concepts and their applications [1]
Intended Learning Outcomes: Develop knowledge and understanding of:

- Advanced design theories, techniques and software for analysis and design of complicated reinforced concrete, prestressed concrete, steel structures and steel-concrete composite plate girders.
- How health and safety is directly linked to specific design exercises such as fire engineering.
- Sustainable design and how this is linked to government targets for development and construction.

Develop ability to:

- Design prestressed concrete beams, use yield line method and finite element method for designing reinforced concrete slabs, design steel structures with second order effects, design steel-concrete composite plate girders, design connections under complex loading.
- Use Eurocodes for safe and effective design of structural elements and systems.

Develop skills in:

- Using fundamental engineering design principles, assisted by current Eurocodes to carry out design of structure elements.
- Utilising engineering principles and analytical techniques, assisted by computing software in complicated structural analysis and design.

O'Brien, Eugene J.Keogh, Damien L., O'Connor, Alan J, Bridge deck analysis / Eugene J. O'Brien and Damien L. Keogh (Department of Civil Engineering, University College, Dublin, Ireland), Alan J. O'Connor (Trinity College, Dublin, Ireland) ; chapter 4 written in collaboration with the authors by Barry M. Lehane (Department of Civil, Structural and Environmental Engineering, Trinity College, Dublin, Ireland), 2015.ISBN: 1482227231

Additional Notes: This module particularly builds on the work of Level 3 structural design and mechanics modules EG-328 and EG-320. Therefore it may not be suitable for visiting and exchange students, unless student has prior knowledge of structural analysis and design equivalent to modules EG-328 and EG-320. Similarly, students entering directly to Level 4 Civil Engineering should familiarise themselves with the content of those Level 3 modules as soon as possible.
Module Aims: The module develops theory and associated solution techniques relevant to structural problems related to plates, shells and solid applications. The basic theoretical concepts are firstly introduced and the underlying governing equations then developed. The first topic considered is the elastic theory of plate bending, which is of fundamental importance in the design and analysis of a large class of engineering structures. This is followed by the limit analysis of plate structures, which is of prominence in reinforced concrete design. A central aspect of the course is the treatment of the membrane analysis of shell structures. Most shell structures operate by their resistance to membrane action, rather than bending, and the course develops solution procedures for a range of practical shell structure applications encountered in both civil and mechanical engineering environments. The course concludes by developing solution strategies for structures subjected to torsion, with particular emphasis placed on the analysis of thin walled structures, such as those encountered in bridge deck construction and aerospace applications.

Pre-requisite Modules: EG-320

Additional Notes: This module particularly builds on the work you have done in the Year 2 Structural Mechanics 2 (a) and (b) modules as well as Year 3 Structural Mechanics 3. You should revise the topics learnt in these modules. This module also assumes that you are familiar with the basic mathematical concepts learnt in Years 1 and 2 mathematics modules.
Module Aims: Recent years have seen an increasingly volatile climate and hence severe floods across the UK and worldwide, which also accompanies with a constant demand for expertise and know-hows for flood risk management. We intend to use this module to facilitate civil and environmental engineering students with necessary engineering skills and techniques for flood risk management with special focuses on current practice and national polices related and climate change impact and sustainability issues. Any student wanting to pursue or develop in a related career, e.g., water managers, consultancy in flood risk management is encouraged to take the module.

Pre-requisite Modules: EG-190; EG-285; EG-329
Co-requisite Modules: EG-M87

Incompatible Modules:

Format: Lectures 20 hours;
Example classes 10 hours;
Directed private study 20 hours;
Private study 40 hours;
Preparation for assessment: 10 hours.

Lecturer(s): Dr Y Xuan, Prof HU Karunarathna

Assessment:
Coursework 1 (12%)
Examination 1 (70%)
Coursework 2 (18%)

Assessment Description: Coursework 1: written coursework counts to 12% of total marks. Zero tolerance for late submission.

Coursework 2: written coursework counts to 18% of total marks. Zero tolerance for late submission.

Examination 1: written exam counts to 70% of total marks. Closed-book exam taking place in January.


Moderation approach to main assessment: Universal non-blind double marking

Failure Redemption: Exam resits according to university regulation.
A supplementary examination will form 100% of the module mark.

Assessment Feedback: Coursework: students will receive feedback via Blackboard according to university regulation.
Examination: feedback will be provided using standard university exam feedback form.

Module Content:
1. Introduction to flood risk management: concepts and approaches [0.5]
2. Water systems and hydrometrics[0.5]
3. Water system modeling for flood risk management[3]:
   3.1 Fluvial flooding: transfer function, lumped model, distributed model, hydraulic models
   3.2 Urban flooding: urban drainage and sewer modelling
   3.3 Flood estimation over ungagged catchment: FEH method
   3.4 Storm surge and overtopping
   3.5 Coastal and estuary flooding.
4. Flood risk, extreme value and reliability analysis [1]
   4.1 Probability theory and its application in flood risk management
   4.2 Design Flood and PMP, PMF
   4.3 Extreme value theory and reliability analysis.
5. FRM Planning, flood hazard and inundation maps, [1]
6 Flood forecasting/Warning and communication systems [1]
7. Options and measures for flood risk management [1]
   7.1 UK and EU Policies and Practices
   7.2 Prevention, mitigation measures and insurance
   7.3 Sustainability issues.
   8.1 Climate change impact
   8.2 Land use change impact
   8.3 Adaptation and resilience building measures.
Intended Learning Outcomes: Upon completion of the module, students are expected to be able to:
1. understand and demonstrate the concept of flood risk management, relevant policies of the UK and EU;
2. understand and be acquainted with the necessary modelling techniques for flood forecasting and flood risk management;
3. use FEH method to estimate flood for ungauged catchment;
4. be accustomed to GIS and use GIS tools to produce flood hazard map and/or analysis;
5. understand and demonstrate the use of probability (extreme value) theory for flood risk analysis;
6. establish and enhance the awareness of the sustainability issues in flood risk management;
7. understand the climate change and other global change impacts on flood risk management;
8. demonstrate the readiness for progressing to relevant profession.

Reading List:
- EU Floods Directive.

Additional Notes: Available to visiting and exchange students.
EG-M62 Group project

Credits: 30 Session: 2017/18 Semester 1 and 2 (Sep-Jun Taught)

Module Aims: This module enables students to participate in a group activity involving a multi-disciplinary approach to achieve a solution to a specific design problem. In most instances it will involve either direct interaction with industry or will be an industrially-related project. Issues other than providing a purely technical solution to the problem will have to be considered in order to achieve a satisfactory outcome to the project.

Pre-requisite Modules: EG-353

Co-requisite Modules:

Incompatible Modules:

Format: Group allocation and team building at start of the project followed by practical sessions group and individual work, meetings with Industrialists as arranged. At least 6 meetings per session with academic and industrial supervisors.

Lecturer(s): Dr K Wada

Assessment: Group Work - Project (100%)

Assessment Description: Assessment will be, as a baseline, 50% for the group and 50% for the individual's contribution to the group. Individual contribution to the project will be assessed by the supervisor (e.g. on the basis of a) individual concept development, analysis and report, b) 'time management' project leader reports, and c) end-of-term presentations; or interviewing the team members individually to check on each student's contributions to the project; and/or adopting the peer review assessment to moderate the group mark).

The actual breakdown of marks within these broad categories is discipline specific (i.e. Aerospace Engineering, Civil Engineering, Electronic and Electrical Engineering, Mechanical Engineering/Product Design Engineering/Materials Engineering). The discipline specific information on assessment criteria will be provided by the respective discipline specific coordinators.

Moderation approach to main assessment: Universal non-blind double marking

Failure Redemption: There is no failure redemption for this module. Failure in this module would normally result in an exit qualification due to insufficient credits having been attained.

Assessment Feedback: Feedback will be given by supervisors as regular part of meetings with students. Formal verbal/written feedback will be provided on the assessed parts of the project.

Module Content: Formulating a full design specification that meets all the likely requirements throughout the working life of the 'product' or 'system'. Consideration of aspects such as: material selection, failure and risk, safety and environmental impact, sustainability, health and safety, maintenance and serviceability, also fitness for purpose and cost implications. Production of a construction/manufacturing/assembly/integration/testing strategy. Consideration of Economic Considerations and Business Plan.

Projects in each discipline will introduce additional constraints as reflected in statutory and industry norms and may have slightly different requirements. Discipline specific briefings will be provided in such cases.
**Intended Learning Outcomes:** On successful completion of this module students will be expected, at threshold level, to be able to:

1) Demonstrate a comprehensive knowledge and understanding of the 'total design' process and project management skills in relation to decision-making and business development in a typical group environment.

2) Critically evaluate the design problems and understand how to apply a range of mathematical and statistical methods, tools and notations proficiently and lead to the solution of engineering design problems.

3) Demonstrate self-direction and originality in tackling and solving problems, use of computational models relevant to the engineering discipline and an appreciation of their limitations, and act autonomously in planning and implementing tasks at a professional or equivalent level.

4) Identify, classify and describe the performance of systems, subsystems and components through the use of analytical methods and modelling techniques.

5) Identify any constraints such as environmental and sustainability limitations, health and safety, security and risk issues, intellectual property, codes of practice and standards wherever relevant and applicable.

6) Generate an innovative design for products, systems, components or processes to fulfill new needs (i.e. to be verified against the design specification and validated against the customer requirement).

7) Apply advanced problem-solving skills, technical knowledge relevant to the engineering discipline and understanding to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal.

8) Deal with complex issues both systematically and creatively, use fundamental knowledge to investigate new and emerging technologies, make sound engineering judgement in the absence of complete data, and communicate their conclusions clearly.

9) Plan for effective project implementation. This includes an ability to:
   - Identify the factors affecting the project implementation (e.g. commercial, economic and social context of engineering processes)
   - Lead on preparing and agreeing implementation plans and method statements

10) Plan, budget, organise, direct and control tasks, people and resources to deliver a project. This includes an ability to:
    - Agree quality standards, programme and budget including cost drivers, and evaluate outcomes
    - Organise and lead work teams, coordinating project activities (understanding of different roles within a project team and take initiative and personal responsibility)
    - Ensure that variations from quality standards, programme and budgets are identified, and that corrective action is taken

**Reading List:**

**Additional Notes:** The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

NOT AVAILABLE to visiting and exchange students.

Generic information and discipline specific information (i.e. Aerospace Engineering, Civil Engineering, Electronic and Electrical Engineering, Mechanical Engineering/Product Design Engineering/Materials Engineering) will be posted on Blackboard.
## EG-M87 Coastal Engineering

**Credits:** 10  
**Session:** 2017/18 Semester 1 (Sep-Jan Taught)

**Module Aims:** This is the main module on the subject of coastal engineering. The module provides the background for undertaking detailed design of coastal flood defences and coastal protection schemes. It covers random waves, tides and littoral processes, as well as some of the more commonly used design equations. It includes wider issues such as: the coastal planning regime in the UK and the impacts of climate change on design. The programme will consist of a series of lectures and problems classes to study worked examples.

**Pre-requisite Modules:** EG223; EG321; EGA331

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures & Example classes 3 hours/week  
Directed private study 4 hours per week

**Lecturer(s):** Prof DE Reeve

**Assessment:**
- Coursework 1 (15%)
- Coursework 2 (15%)
- Examination 1 (70%)

**Assessment Description:**
- Coursework 1 - group written assessment on design wave specification (15%)
- Coursework 2 - group written conceptual design assessment (15%)
- Exam (70%) - Standard closed-book end-of-semester examination, that may cover all topics seen in the module.

Failure to sit the exam or class test will result in a zero mark being recorded for the corresponding component.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** A supplementary examination will form 100% of the module mark. Closed book.

**Assessment Feedback:** Feedback on coursework via written comments and comments in class.  
Feedback on exam via normal procedure; in subsequent years via overview of generic issues arising from previous examinations.

In addition students may receive feedback through weekly surgery sessions held by the Module Director.

**Module Content:** Indicative syllabus -

- Introduction: conceptual design for coastal defence; sustainable shoreline management in the UK; overview of design process
- Design wave specification: Characteristics of wind waves and swell; concept of a random sea. Time and frequency domain parameters, Rayleigh distribution, energy and directional spectra. Introduction to principles of frequency analysis.
- Wave transformation: Refraction, shoaling and diffraction of monochromatic waves and directional spectra.
- Water level variations: tides and surge.
- Extreme events.
- Flood defences: Types & materials (embankments, revetments and seawalls); wave overtopping; formulae and methods; design criteria.
- Coastal protection: Types & materials (revetments, groynes, breakwaters); soft engineering options (renourishment, recycling); beach modelling.
- Reliability & risk: flood risk assessment.
### Intended Learning Outcomes: Upon completion of this module students should be able to:

- Identify the main categories of coastal defence schemes, their characteristics and their place in wider coastal management practice
- Understand the main descriptors of random waves and their use in defining the design wave
- Understand the basic elements of tidal theory and harmonic analysis;
- Classify the tidal type from the amplitudes of tidal harmonics, and estimate tidal range and main tide levels
- Determine non-tidal contributions to water level from empirical formulae
- Calculate wave overtopping volumes
- Calculate armour requirements
- Perform calculations for preliminary design of simple sea defences
- Estimate the probability of functional failure of basic flood defence structures
- Identify the main options for coastal protection schemes
- Appreciate sustainability and 'Soft' engineering options and methods

### Reading List:

### Additional Notes: A background knowledge of coastal processes and soil mechanics is assumed. The material covered in EG223, EG321 and EGA331 provides this.

Available to visiting and exchange students with suitable pre-requisite knowledge

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
# EGEM07 Fluid-Structure Interaction

**Credits:** 10 Session: 2017/18 Semester 2 (Jan - Jun Taught)

**Module Aims:** The understanding and the computer simulation of fluid-structure interaction (FSI) is of increasing importance in many areas of modern engineering including Civil, Mechanical, Medical, Chemical and Aerospace Engineering. This module covers the mechanics of fluid-structure interaction as well as the numerical strategies for the computer simulation of such problems. Various phenomena, including wing divergence, oscillating pipes, wind turbine performance, vortex-induced vibrations, galloping and flutter, are studied and different approaches to the computer simulation of fluid-structure interaction are discussed. In the context of the computational strategies, the focus is on solution methods for the coupled system of differential equations that describe the interaction between the fluid flow and the structure.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** lectures and example classes: 2 hours per week; online teaching material: equivalent to 1 hour per week; private study: 4 hours per week; revision: 30 hours

**Lecturer(s):** Dr WG Dettmer

**Assessment:** Examination 1 (85%)
Assignment 1 (15%)

**Assessment Description:**

Examination: This is a closed book examination. The examination forms 85% of the module mark.

Assignment: Examples and Applications
This is an individual piece of coursework. It is worth 15% of the module mark.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** A supplementary examination will form 100% of the module mark.

**Assessment Feedback:** General feedback on the assignment will be given in a lecture. Individual feedback will be given in office hours.

**Module Content:**

Fluid-Structure Interaction and Aeroelasticity:
* lift and drag forces, pitching moment,
* wing divergence,
* added mass,
* oscillating pipes,
* ship roll,
* vortex-induced vibration, lock-in,
* galloping, flutter,
* wind turbines

Computational Solution Strategies:
* basics of computational modelling of fluid flow and structural dynamics,
* interface modelling, weak and strong coupling,
* Gauss-Seidel iteration, relaxation, convergence, Aitken acceleration,
* monolithic and partitioned Newton-Raphson methods,
* staggered schemes

**Intended Learning Outcomes:** On successful completion of this module, the students are expected to be able to
* assess the stability of different FSI systems (assessed in the assignment and in the exam),
* construct numerical solution methods for basic FSI systems (assessed in the assignment),
* predict the performance of computational strategies for FSI computer simulations (assessed in the assignment and in the exam).


**Additional Notes:** The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
Lecture notes, pencasts, examples, exercises and past examination papers will be available on Blackboard.
**Module Aims:** This module aims to develop the understanding and skills necessary to analyse linear structures under general dynamic, including earthquake loading, and to understand the use of time stepping schemes for linear dynamic and transient problems.

**Pre-requisite Modules:** EG-260

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures & Example classes (30h); Directed private study (30h)

**Lecturer(s):** Prof Y Feng

**Assessment:**
- Examination 1 (60%)
- Project (40%)

**Assessment Description:** Formal lectures, example classes.

**Moderation Approach to Main Assessment:** Universal second marking as check or audit

**Failure Redemption:** Redeem failed component in 100% resit examination in August.

**Assessment Feedback:** Offer one-to-one sessions to discuss the student’s individual project; and use the College’s standard module feedback procedure to provide the students with issues associated with the final examination.

**Module Content:**

- **Introduction:** Dynamic effects on structures, Engineering disasters, design issues. [1]

- **Single Degree of Freedom Problems:**
  - the SDOF spring-mass system, equivalent SDOF structures - energy method, analytical solution of SDOF problems, step by step solution methods, earthquake loading, response and design spectra, Eurocode-8 elastic spectrum. [15]

- **Multiple Degree of Freedom Problems:**
  - natural modes and frequencies of vibration, modal decomposition, reduction methods, earthquake loading, shear building model, design considerations. [9]

- **Distributed Mass Systems:**
  - finite element discretization and formulations. [4]

- **Revision** [1]

**Intended Learning Outcomes:** On the completion of the module, students are expected to be able to

- aware of possible disastrous consequences of structural failures under dynamic loadings, such as strong wind, wave and particularly earthquakes.
- demonstrate a knowledge and understanding of: basic dynamic concepts of SDOF systems such as dynamic magnification, resonance, damping.
- apply the Rayleigh method to simplify a complex structure to a SDOF system;
- perform earthquake analysis for a SDOF system to establish the response and design spectra.
- follow Eurocode-8 to conduct elastic earthquake analysis of a regular-shaped multi-story frame structure.
- compute the consistent and lumped mass matrices of a quadrilateral element;
- use a computer language to analyse the accuracy and stability of the Newmark integration method, and generate an earthquake spectra, based on which to conduct an earthquake analysis of a multi-story building, and write a technical report.


**Additional Notes:** Assessment: Written, open book, examination (2 hrs) at the end of Semester 1 accounts for 60% of the marks, the remaining 40% are awarded to an individual project, for which students are expected to solve a dynamical problem using Excel/Matlab etc and write a technical report on their findings. Penalty for late submission of course work is zero mark in the course work.

The detail of the individual project will be provided at the beginning of the course.
## EGIM08 Computational Plasticity

**Credits:** 10 Session: 2017/18 Semester 2 (Jan - Jun Taught)

**Module Aims:** This module is concerned with basic concepts and methods of computational plasticity. Essential steps required in numerical integration of elasto-plastic constitutive models are first discussed in a one-dimensional setting. Concepts of plasticity under multiaxial stress states are introduced and several yield criteria are described including von Mises, Tresca, Mohr-Coulomb and Drucker-Prager yield criteria. Details of numerical integration are provided for the von Mises yield criterion. Understanding of basic concepts and practical applications are strengthened through the programming exercises focusing on one-dimensional problems, and use of computational codes under multiaxial state of stress. Computer simulations of structural and geotechnical problems are performed, with the objective of understanding the concepts of engineering failure and limit state.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures (20h); Example classes and Laboratory work (10h). Directed private study 3h per week.

**Lecturer(s):** Prof D Peric

**Assessment:**

<table>
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<tr>
<th>Assessment</th>
<th>Examination 1 (50%)</th>
<th>Assignment 1 (20%)</th>
<th>Assignment 2 (30%)</th>
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**Assessment Description:**

Examination 1 - Standard 2 hour university examination worth 50% of the final mark. This is a closed book examination.

The coursework will consist of two individual projects that will require both hand calculation and computer simulations. Computer simulation will require certain amount of programming and use of the existing finite element software package Elfen. The project reports should consist of two parts: (i) a discussion related to general aspects of formulation and computational treatment of the problem under consideration, (ii) description of numerical solution of an individual problem.

Coursework 1 - Hand calculation and numerical solution in MATLAB will be used to obtain solution of simple 1-D elasto-plastic problem. Coursework 1 will contribute 20% of the final mark.

Coursework 2 - Short hand calculation and computer simulation in commercial code will be used to obtain solution of a 2-D engineering problem. Coursework 2 will contribute 30% of the final mark.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** Exam re-sits according to university regulations. Normally, a supplementary examination will form 100% of the module mark.

**Assessment Feedback:** Examination 1 - Standard university exam feedback form.

Coursework 1 and 2 - Marked assignments with comments will be provided to students for inspection.

**Module Content:**

### Intended Learning Outcomes:
Students should be able:
- Develop understanding of constitutive description of elasto-plastic materials.
- Identify different constitutive models for describing material behaviour including von Mises, Tresca, Mohr-Coulomb and Drucker-Prager elasto-plastic models.
- Develop fundamentals of computational modelling of inelastic materials with emphasis on rate independent plasticity.
- Identify and apply different methodologies for discretisation of different time evolution problems, and rate-independent elasto-plasticity in particular.
- Develop practical skills related to modelling of inelastic history dependent materials.
- Formulate and implement a computational procedure for integration of rate-independent elasto-plasticity in 1-D.
- Perform analysis of engineering problems in elasto-plasticity by employing a commercial finite element package.
- Identify failure modes in engineering structures and geomechanics.

### Reading List:

### Additional Notes:
- Failure to attend activities that are a module requirement will normally mean that you cannot sit the final exam in the module.
- Zero tolerance will apply for late submissions of the assignments.
- Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.
### EGIM27 Reservoir Modelling and Simulation

**Credits:** 10 Session: 2017/18 Semester 2 (Jan - Jun Taught)

**Module Aims:** Subsurface reservoir modelling applies to petroleum reservoirs, aquifer remediation, carbon sequestration and energy storage. This module provides an introduction to subsurface reservoir modelling at masters level.

**Pre-requisite Modules:** EG-189; EG-190; EG-201; EG-228; EG-399

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures 20h; Examples 10h; Directed Private Study 70h

**Lecturer(s):** Prof MG Edwards

**Assessment:**
- Examination 1 (70%)
- Assignment 1 (15%)
- Assignment 2 (15%)

**Assessment Description:** Closed book examination (70%) and 2 assignments (15% each) involving analytical work and calculation.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** Supplementary closed book exam in the month of August following the first exam in May/June. Supplementary is normally a closed book exam marked out 100%, result capped at 50%.

**Assessment Feedback:** Feedback on assessed work and formative work is given in example classes and via blackboard and blackboard's gradecentre. Specific issues and questions are answered throughout the module including example classes. Feedback on formal examinations is given via the web feedback template.

**Module Content:**
- Introduction to petroleum reservoirs; the flow variables, medium variables.
- Equation Types; Principles of mass conservation.
- Single phase flow, Darcy's Law.
- Potential Flow.
- Permeability tensors and Upscaling. Layered medium and flow.
- Well model and radial flow.
- Multiphase flow, Darcy's Law.
- Buckley Leverett Flow. Oil recovery calculation.
- Unstable flow.
- Flow on an incline and effects of gravity.
- Upscaled Flow models
- Convection Diffusion
- Pollutant, Oil spill
- (Knowledge of MATLAB is assumed)

**Intended Learning Outcomes:**

A knowledge and understanding of:
The basic principles of mass conservation and formulation of single and multiphase conservation laws according to equation type. Their fundamental solutions. Concepts of scale and upscaling while maintaining medium properties. Stable and unstable flow regimes. Effect of mobility ratio and gravity on oil recovery and water breakthrough. Convective and diffusive pollutant modelling.

An ability to (thinking skills):
Understand and formulate flow models, boundary conditions and procedures to solve illustrative problems. Appreciate the coupled form of the general system of equations.

An ability to (practical skills):
Understand and interpret practical implications, limitations of flow model solutions and use of models in simulation.

An ability to (key skills):
Study independently, use library resources. Effectively take notes and manage working time.
Bear, Jacob, Dynamics of fluids in porous media / Jacob Bear, Dover, 1988, 1972.ISBN: 9780486656755

Additional Notes: Lecture notes provided.

Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.

Assessment: 70% closed book examination. The closed book examination is of 2 hours duration. 30% continuous assessment assignments, comprised of 2 assignments each one worth 15%.

Practical Work: Exercises, analytical /project given during course