Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

MSc BIOMEDICAL ENGINEERING

(FHEQ LEVEL 7)

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

The Faculty of Science and Engineering 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 Faculty of Science and Engineering 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 Faculty of Science and Engineering directly if you require further information.

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Engineering and Applied Sciences **Head of School: Professor Serena Margadonna**	
School Education Lead	Professor Simon Bott
Head of Biomedical Engineering	Professor Huw Summers
Biomedical Engineering Programme Director	Dr Sanjiv Sharma Sanjiv.Sharma@Swansea.ac.uk
MSc Coordinator	Dr Raoul van Loon R.Vanloon@Swansea.ac.uk

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions.
We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

MSc (FHEQ Level 7) 2023/24
Biomedical Engineering
MSc Biomedical Engineering

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-M321 **Image-based Biomaterial Fabrication & Biomechanical Testing** **20 Credits** **Dr R Van Loon/Dr H Arora** **CORE**	**EG-M160** **Advanced Microfluidics** **10 Credits** **Dr F Del Giudice** **CORE**
EGIM16 **Communication Skills for Research Engineers** **10 Credits** **Dr SA Rolland/Dr T Lake** **CORE**	**EG-M190** **Social, environmental and economic context of research** **10 Credits** **Dr SA Rolland/Prof JC Arnold** **CORE**
EGNM05 **Bio-nanotechnology** **10 Credits** **Dr CJ Wright** **CORE**	**EG-M332** **Medical Imaging & Informatics** **20 Credits** **Prof P Rees** **CORE**
EGNM07 **Principles of Nanomedicine** **10 Credits** **Dr S Sharma/Prof OJ Guy** **CORE**	
Dissertation	
EG-D14 **MSc Dissertation - Biomedical Engineering** **60 Credits** **Dr AJ Williams/Dr R Van Loon** **CORE**	
Total 180 Credits	

Optional Modules

Choose exactly 10 credits

EG-M83	Simulation Based Product Design	Dr AJ Williams/Dr B Morgan	TB2	10 (CORE)

And

Choose exactly 10 credits

Students who have studied EGA336 in Swansea as part of their undergraduate degree will have to elect EG-M97 Advanced Solid Mechanics or EG-M106 Polymer Processing.

EG-M106	Polymer Processing	Prof JC Arnold/Mr D Butcher	TB1	10 (CORE)
EG-M326	Biomedical Flows in Physiology and Medical Devices	Dr R Van Loon	TB1	10 (CORE)
EG-M97	Advanced Solid Mechanics	Dr C Wang	TB1	10 (CORE)

And

Choose exactly 10 credits

Students who have studied EGA308 in Swansea as part of their undergraduate degree will have to elect EGM403 Implant Engineering 2.

EG-M328	Implant and prosthetic Technology	Dr CJ Wright/Dr F Zhao	TB2	10 (CORE)
EGM403	Implant Engineering 2	Dr S Sharma/Dr CJ Wright	TB2	10 (CORE)

Or
Choose exactly 20 credits

EG-M83	Simulation Based Product Design	Dr AJ Williams/Dr B Morgan	TB2	10 (CORE)
EGM403	Implant Engineering 2	Dr S Sharma/Dr CJ Wright	TB2	10 (CORE)

And
Choose exactly 10 credits
Students who have studied EG-3055 in Swansea as part of their undergraduate degree will have to elect EG-M106 Polymer Processing

EG-M106	Polymer Processing	Prof JC Arnold/Mr D Butcher	TB1	10 (CORE)
EG-M327	Tissue Engineering	Dr CJ Wright	TB1	10 (CORE)

EG-D14 MSc Dissertation - Biomedical Engineering

Credits: 60 Session: 2023/24 June-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Dr R Van Loon

Format: Directed private study (including meetings with supervisors): 600 hours.

Each student is supervised in accordance with the University's Policy on Supervision, with a minimum of three meetings held. Typically a student will meet with their supervisor weekly (i.e. 10-15 hours total contact time). A careful record should be kept, agreed between supervisor and student, of all such formal meetings, including dates, action agreed and deadlines set.

Delivery Method: The module is delivered primarily as an individual research project. The student is expected to liaise with the supervisor on a regular basis, with a minimum University requirement of three formal meetings for full-time students. In the case of part-time students it is recommended that a minimum of four meetings are held. Ideally, contact should be more regular, with at least one meeting a week to discuss the development and progress of the project. Depending on the project the student would be expected to carry out this research individually and to complete the necessary risk assessments and training required to work on an industrial site or within laboratory facilities of the University.

Module Aims: The module aims to develop fundamental research skills. It comprises the development of supervised research work leading to a dissertation in the field of the Master's degree programme. The specific research topic will be chosen by the student following consultation with academic staff.

Module Content:

Study for the dissertation, which may be based on practical, industrial, or literature work, or any combination of these, is primarily carried out over a period of about 12 weeks, with the dissertation being submitted at the end of September. Preparatory work on the dissertation may take place during Part One of the programme but students will only be permitted to submit their dissertation following successful completion of Part One.

In conducting the research project and dissertation, the student will be exposed to all aspects of modern information retrieval processes, the organisation and resourcing of research and the organising and presentation of experimental data. The student must make inferences on conclusions, based on the evidence provided and supported by the research work. Furthermore they must assess the significance of this work in relation to the field and make suggestions about how further work could improve or clarify the research problem. The results of the project will be disseminated in a substantial dissertation demonstrating the student's ability to research a subject in depth.

The student will meet regularly with the supervisor to ensure that the project is well developed and organised. Progress will be monitored.

Intended Learning Outcomes:

Technical Outcomes

On completion of this module, students should have the ability to:

- Investigate a research topic in detail;
- Formulate research aims;
- Devise and plan a research strategy to fulfil the aims;
- Carry out research work - undertake a literature search, a laboratory based or computer based investigation or a combination of these;
- Gather, organize and use evidence, data and information from a variety of primary and secondary sources;
- Critically analyse information;
- Make conclusions supported by the work and identify their relevance to the broader research area;
- Resolve or refine a research problem, with reasoned suggestions about how to improve future research efforts in the field;
- Produce a report (dissertation), with the findings presented in a well organised and reasoned manner.

Accreditation Outcomes (AHEP)

- A comprehensive understanding of the relevant scientific principles of the specialisation (SM7M)
- A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM8M)
- Understanding of concepts relevant to the discipline (SM9M)
- Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA7M)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D9M)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10M)
- Ability to generate an innovative design for products, systems, components or processes to fulfil new needs (D11M)
- Advanced level knowledge and understanding of a wide range of engineering materials and components (P12M)
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD (G2)
- Monitor and adjust a personal programme of work on an on-going basis (G3)
- Exercise initiative and personal responsibility, which may be as a team member or leader (G4)

Assessment: Report (100%)

Assessment Description: The research project and dissertation forms Part Two of the Masters degree.

Students should refer to:
https://www.swansea.ac.uk/academic-services/academic-guide/postgraduate-taught-awards-regulations/standard-taught-masters/

In particular, section 14 will provide further Information about dissertation preparation and submission.

The word limit is 20,000. This is for the main text and does not include appendices (if any), essential footnotes, introductory parts and statements or the bibliography and index.

Each student is to submit an electronic copy of their dissertation through the Turnitin link on Canvas. The online system will automatically check the similarity of the report.

The dissertation must contain:

• A statement that it is being submitted in partial fulfilment of the requirements for the degree;
• A summary of the dissertation not exceeding 300 words in length;
• A statement, signed by you, showing to what extent the work submitted is the result of your own investigation.
• Acknowledgement of other sources shall be made by footnotes giving explicit references. A full bibliography should be appended to the work;
• A declaration, signed by you, to certify that the work has not already been accepted in substance for any degree, and is not being concurrently submitted in candidature for any degree;
• A signed statement regarding availability of the thesis.

The dissertation is marked by the supervisor and another member of staff and sent to an External Examiner for moderation. An Internal Exam Board is then held to confirm the mark. Finally, all marks are ratified at the University Postgraduate Taught Examination Board.

Deadlines as follows:

MSc Mechanical Engineering (without resits) - September 30th

MSc Mechanical Engineering (with resits) - December 15th

Moderation approach to main assessment: Universal Double Blind Marking of the whole cohort

Assessment Feedback: Informal feedback will be given during regular meetings with supervisors. The supervisor will also provide an assessment of the project drafting skills during the planning of the dissertation. Work will be returned according to specified deadlines and accompanied by constructive comment.

A Feedback session will be given to any student who fails their dissertation and is permitted by the Award Board to resubmit their work.

Failure Redemption: Candidates who fail the dissertation are given an opportunity to resubmit the dissertation within 3 months of the result of the examination if a full-time student or 6 months for part-time students. Such students will be given one formal feedback session, including written feedback on the reasons for failure, immediately following confirmation of the result by the University Postgraduate Taught Examination Board. The opportunity to resubmit will only be offered to students who submit a dissertation and are awarded a fail. Those candidates who do not submit a dissertation will not be offered a resubmission opportunity.

The marking process for dissertation resubmissions is the same as for first submissions. The dissertation will be marked by the supervisor and the member of staff who marked the first submission, and sent to the External Examiner for moderation. The mark will be confirmed at an Internal Exam Board and ratified at the University Postgraduate Taught Examination Board. The resubmission will be capped at 50%.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

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

If an extension is deemed appropriate a Postgraduate Taught Masters 'Application for Extension to the Submission Deadline/ Period of Candidature' Form will need to be submitted as follows:

• 31 August – deadline for Part Two students (non-resit students).
• 8 November – deadline for Part Two Students (students who had resits).

EG-M106 Polymer Processing

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules: EG-M103

Lecturer(s): Prof JC Arnold, Mr D Butcher

Format: 20 hrs lectures
10 hrs laboratory
70 hrs Directed private study

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Lectures/Laboratory demonstrations

Module Aims: The module will provide a deeper understanding of the technology of plastics processing. The material covered will cross cut the engineering disciplines of advanced manufacturing technology and polymer science to broaden the technical and industrial context of polymer processing. Within the content of the module simulation software will be applied to industrial case study examples for critical evaluation. In addition, the application of polymer replication technologies within the emerging field of micro manufacturing will be presented, focusing on the advantage and limitations of size effect and length scale integration. The module will include practical demonstration laboratories and also include industrial visits.

Module Content:

• Injection moulding: processing cycle
• Material selection criteria and processing consideration
• Computational simulation
• Microcellular injection moulding
• Polymer melt rheology
• Mould cooling systems

Intended Learning Outcomes:

Accreditation Outcomes (AHEP)
MEng:
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Understanding of appropriate codes of practice and industry standards (P6)

MSc:
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9m)
- Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate (EL11m)

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Two hour examination, choice of three questions out of four.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Examination feedback is given using the Faculty of Science and Engineering standard form.

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

MEng finalists are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Late assignments will not be marked.

EG-M160 Advanced Microfluidics

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr F Del Giudice

Format: Lectures: 22 hours. Office Hours: 11 hours. Private study: 100 hours

Delivery Method: The lecture will first present the theoretical foundation for each topic. Students will be guided by the lecturer in the critical analysis of existing microfluidic platforms in order to identify potential limitations. Students will also be guided towards the design of alternative platforms with better performances. Sometimes, students will be asked to complete preliminary readings in preparation to the lecture. Two final lectures will be delivered in the laboratory to further strengthen and visualise the concepts learned during the module.

Module Aims: Microfluidics is the set of science and technology at the micrometer scale. In the last 30 years, microfluidic devices have been widely employed for a variety of engineering applications, including cell and particle separation, fabrication of fiber, production of droplets and microparticles and characterization of complex fluids. In all these applications, chemical engineers have employed their skills to work across scientific fields in order to promote significant improvement in many areas including diagnostic, molecule detection and advanced manufacturing. Microfluidics has enormous advantages compared to conventional techniques such as small volume of samples required (less than 1 ml), easy and accurate control of flow parameters, larger sensitivity, compact size.

In this course, we will introduce the advanced phenomena occurring at the micrometer scales. We will see how complex flows can be used to drive a variety of further phenomena including alignment and spacing of particles, droplet formation, particle fabrication, and cell separation. We will also see manufacturing of materials using Microfluidics devices together with recent applications in machine learning and AI. We will employ a critical approach to identify limitations of existing microfluidic technologies and we will develop a mindset oriented towards problem solving (i.e., positive attitude) and design of alternative devices for targeted applications.

Module Content: Introduction to the course. Bounded and unbounded flow. Navier-Stokes Equations. Particle migration in Newtonian and non-Newtonian liquids. [2]

Particle focusing and separation in Stokes flow. [2]

Inertial flows applied to Microfluidic applications [4]

Complex viscoelastic fluids applied to Microfluidic applications [4]

Formation of droplets in Microfluidic flows with application single-cell encapsulation and material synthesis [4]

PC Lab 1: Implementing ChatGPT algorithms to review the state-of-the-art on microfluidic topics. [2]

Pc Lab 2: Implementing ChatGPT algorithms to design microfluidic devices. [2]

Pc Lab 3: Implementing ChatGPT algorithms to prepare a critical analysis of a microfluidic design. [2]

Intended Learning Outcomes: By the end of the module the student will be able to:

1. Critically analyze a research paper featuring microfluidic applications: identify strength, limitations and future directions

2. Design microfluidic devices for targeted applications.

Assessment: Coursework 1 (100%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Coursework (100%): Extended coursework through producing a report (100%). Students will be asked to employ ChatGPT to present an overview of the state-of-the-art related to specific microfluidic topics (30%), design a microfluidic device for a specific application (35%), and prepare a critical analysis of a microfluidic device taken from a published paper (35%). This component will be carried out at home and students will have a pre-defined amount of time to complete and submit the report.

Redemption of failed coursework: Same rules as for the Coursework.

Moderation approach to main assessment: Not applicable

Assessment Feedback: Students will receive feedback during lectures, laboratory activities, workshop and office hours.

Failure Redemption: Coursework (100%): Same rules as Coursework 1

Additional Notes: Available to visiting and exchange students.

A scheme of direct private study supports relevant reading material provided. Notes prepared by the lecturer are also available.

The lectures will not be recorded and the students are expected to engage in the class activities. The lectures will be highly interactive and the students will be asked to contribute to discussions in order to receive direct feedback from the lecturer: this approach has been widely appreciated by previous cohorts of students in terms of receiving relevant and specific feedback in preparation for the exam. Therefore, this type of lecture is not appropriate for lecture recording. Students that cannot attend one or more lectures are warmly invited to visit the lecturer during office hours to receive feedback. All the activities will be sign-posted on Canvas and the material available will be sufficient to complete successfully the final assessment. Lecture attendance is the opportunity to engage directly with the lecturer and work with peers to solve microfluidic problems.

EG-M190 Social, environmental and economic context of research

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr SA Rolland, Prof JC Arnold

Format: 30 formal contact hours
10 x 1 hour lectures
10 x 2 hour interactive workshops

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Lecture and workshops

Module Aims: There is an increasing need for engineers to work towards complex, so called 'wicked problems', for example the secure supply of energy. This necessitates a holistic approach and involves making decisions based on a range of different factors, and consideration for economic, ethical, social, political and environmental, as well as technical limitations.

Obtaining and making sense of such information involves types of knowledge and the use of tools and techniques that have not always been traditionally used within engineering disciplines. For example, ethical issues concerning negative impacts on environment or society may raise questions of value, duty or morality and requires the application of moral reasoning rather than scientific reasoning.

During this module we will make use of a variety of engineering case studies which exemplify the need to consider non-technical aspects of engineering projects. We will use qualitative research approaches and ethical frameworks to help in our engineering decision making. We will also consider the role of the engineer in policy making.

Module Content: Different types of knowledge and research approaches used to obtain different types of knowledge and information
The use of moral reasoning and ethical frameworks
Policy process and the role of the engineer in informing policy

Intended Learning Outcomes: Technical Outcomes
By the end of this module students should be able to:
Knowledge of the stages of a research project and how to select appropriate research methods.

Accreditation Outcomes (AHEP)
Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M/ ET2fl)
Awareness that engineering activities should promote sustainable development (EL11M / ET4fl)

Assessment: Coursework 1 (60%)
Coursework 2 (40%)
Participation Exercise (0%)

Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Assessment One: Selection of a contemporary engineering topic/project. Outline of the role of different types of knowledge and information needed to inform project. Ethical, economic, social and environmental evaluations of the engineering issues involved.
Assessment Two: A policy brief (choice of contemporary engineering topic)

PASS/FAIL COMPONENT Minimum attendance and contribution to workshop sessions
Note, that this module cannot be passed if this pass/fail element is not passed. If you do not meet the requirements of the Pass/Fail component, you will receive a QF outcome. This means that you will be required to repeat the failed component(s), even if your module mark is above 50%

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit
Assessment Feedback: Formative and peer feedback will be given in group/workshop sessions Feedback during Q&As in lecture and example classes. Lecturer available for ad-hoc feedback during office hours. Written feedback on all coursework submitted
Failure Redemption: Students will be provided with the opportunity to resubmit failed components. If engagement in group project activities is below required level, no supplementary will be possible and module will have to be resat in the following year.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. .

EG-M321 Image-based Biomaterial Fabrication & Biomechanical Testing

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr R Van Loon, Dr H Arora

Format: - 1 hour of lectures for 11 weeks
- 3 hours of lab for 11 weeks and/or 3 hours of pc class for 11 weeks

Delivery Method: One hour per week will be allocated to teach the theory behind a given software, a material or an experimental technique.

Up to three hours will be allocated for lab work or software workshops to train the students in a range of experimental techniques.

Module Aims: This module aims to teach the student how theory, modelling, image processing and experimentation go hand in hand. The students will get exposed to a range of softwares and will experience how these can be integrated into an experimental workflow. At the basis of the work lie images. These can come from CAD softwares (solid works) or from image segmentation using scans from MRI, CT or ultrasound. These resulting geometries can then be created in the lab through casting or 3D printing using soft materials such as silicones or hydrogels. After the samples have been prepared the students can test them (e.g. mechanical testing) and analysed further using finite element analysis. The module will expose the students to a variety of scenarios to give them a awareness and appreciation of a broad set of techniques used in biomedical engineering, which will help them adapt easily to any lab based setting.

Module Content: Course elements:
• Creation of images using CAD (Solidworks) or image processing softwares (such as 3Dslicer/mimics and ntopology) (Evaluated in: Coursework).
• Fabrication of samples of different materials through casting or 3D printing (SLA or FDM) (Evaluated in: Coursework).
• Testing of samples (Evaluated in: Coursework).
• Data analysis using different softwares such as Matlab and FEBio (Evaluated in: Coursework).

Intended Learning Outcomes: On successful completion of this module, students should be able, at threshold level, to:
• Demonstrate a knowledge and understanding of: a range of experimental techniques (Evaluated in: All assessments, SM3).
• Understand and follow experimental procedures across a range of biomedical engineering applications (Evaluated in: All assessments, P3, SM3).
• Post-process and analyse quantitative experimental data to identify, classify and describe the performance of various systems (Evaluated in: All assessments, EA2).
• Maintain accurate informal notes and report the technical findings in professional written form (Evaluated in: All assessments, D6).

Assessment: Laboratory report (40%)
Laboratory report (60%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: - The students will keep an experimental logbook for each week that are pass-fail
- The students will submit 2 lab reports over the course of the semester

Moderation approach to main assessment: Not applicable

Assessment Feedback: The students will get instant feedback on their work in the lab and on their logbooks. Written feedback will be given on their lab reports.

Failure Redemption: The students will be able to resubmit the final lab report, which will then count 100% towards the final mark. A resubmission will be capped.

Additional Notes: Module code reserved by r.vanloon on 28/09/2022 15:23:38

EG-M326 Biomedical Flows in Physiology and Medical Devices

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr R Van Loon

Format: Lectures:20 hours
Revision: 2 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: Delivery of both teaching and assessment will be blended including self-directed activities online (CANVAS) and on-campus. The students will be provided with lecture notes, videos around specific topics and OneNote notes on CANVAS. During in-person classes biofluids and bio-flows in a wider context will be discussed with a range of examples. Also practice examples will be covered in more tutorial style in-person classes.

Module Aims: The purpose of the module is to develop knowledge and understanding of biomedical flows in the human body or in medical devices. The students will learn about the different types of flows, such as cardiovascular, respiratory, lymphatic, synovial, cerebrospinal etc..., and will learn ways to quantify and analyse these flows using mathematical tools. The module covers the fundamental physics of flows, the fundamental physics of fluids and the applications in the biomedical field.

Module Content: Module content: [approximate lecture hours]

Introduction [2]

PART I: Governing equations [7]
• Physical forces on a representative volume unit (normal stresses, shear stresses, pressures)
• Deriving Navier Stokes: Conservation of mass and momentum on a fluid volume
• Derivation of Bernoulli, Stokes, Euler equations from Navier Stokes
• Navier Stokes in its dimensionless form

PART 2: Rheology of non-Newtonian fluids and Hemo-rheology [7]
• Non-Newtonian/viscoelastic biofluids, shear-rate dependent viscosity, thixotropic/rheopectic behaviour, transient response
• Multi-component flows, Non-Newtonian inelastic models, pseudo-plastic fluid, dilatant fluid, Bingham fluid, viscoelastic
models.
• Blood composition, rheological properties and constitutive modeling, inelastic models, refined blood models.
• The Fahraeus-Lindqvist effect, hematocrit distribution, the Fahraeus effect.

PART 3: Physiological Flows [6]
• The heart, anatomy of the heart, principle of heart valve closure, mechanism of cardiac pumping: systole and diastole.
• Unsteady pulsatile pipe flow, the Windkessel model, Korteweg-Moens wave speed, the Womersley solution, Womersley
number and Stokes layer, limit of small Womersley number, unsteady flow rate, applications to real physiological conditions.
• Hemodynamics flow structures, curved vessels: secondary flows, flow separation and recirculation, wall Shear stress,
oscillatory shear index.
• The progression and development of atherosclerosis, initiation and development, the role of hemodynamics, inks between
LDL accumulation and the hemodynamic environment.

Intended Learning Outcomes: Demonstrate an understanding of:
- the momentum and mass balances applied to a representative volume unit of fluid.
- the Navier-Stokes equations and the physical meaning of each of its terms.
- how to reduce the Navier-Stokes equations to more easily used equations depending on a set of assumptions.
- flows in the human physiology, medical devices and its clinical relevance. This will include cardiac, vascular, lymphatic, and respiratory flows.
- the role of biofluid mechanics in health and disease.

The students will be able
- to apply these skills to a variety of flow problems in physiology and medical devices.
- to demonstrate an ability to characterise various types of fluids and flow regimes found in physiology.

(Evaluated in: Assignment and Exam, SM4, SM5, EA2, EA3)

Assessment: Examination (50%)
Assignment 1 (50%)

Assessment Description: The examination will be a 2 hour written examination where students have to answer all questions.

The assignment will be in the form of a report and will focus around real-life applications of fluid flow such as human physiology and medical devices. The students will do this report in groups of 2.

If the students fail the assignment, they will have 1 chance to resubmit. The mark will be capped.
If the students fail the exam, they will have to sit a resit examination in august. The resit examination will be a 2 hour written examination where students have to answer all questions.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: The assignment reports will be marked and comments will be provided on the work. Generic mistakes to the assignment will be discussed in class.

Engineering has designed a standard feedback form that will be filled out. This way the students will get an appreciation of the detailed statistics of the exam and the most common mistakes made.

Failure Redemption: Students will have to pass both the assignment and the exam.
If you are eligible for a resit examination this will take the form of supplementary examination worth 50%.
If you are eligible for resit of the assignment this will take the form of a resubmission of the assignment report worth 50%.

Additional Notes:
Available to visiting and exchange students.

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

EG-M327 Tissue Engineering

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CJ Wright

Format: Lectures 20 hours
Example Classes and Presentations 5 hours
(Directed private study 75 hours)
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: Lectures

Assessment: 80% written examination, 20% assignment.

Module Aims: Modern medicine is looking to tissue engineering to solve many disease states through the harnessing of the body's own repair mechanisms. Every day in the news we are seeing exciting glimpses into the application of tissue engineering for the replacement of tissues and eventually organs within the human body. Thus, the aim of the module is to provide the students with a rigorous understanding of the underlying themes of tissue engineering and equip them for the future developments that will impact significantly on their career as biomedical engineers. The module starts with an examination of how cells grow and differentiate into tissues, this is from an engineering prospective looking at the cell interactions, adhesion and mechanics. The importance of stem cells in regenerative medicine will also be discussed. In order to engineer tissue the cells environment must be controlled so the module features a comprehensive examination on the design and production of scaffolding to guide cell growth and differentiation. This is accompanied by a similar assessment on the use of specialist bioreactors to amplify cell numbers, entrap cells in scaffolds and condition them so that they will survive implantation. In the latter part of the module case studies are used to reinforce the processes involved in tissue engineering. Thus, the module finishes with a consideration of the current state of the art of tissue engineering with applications including cartilage, bone, skin and artificial organ engineering.

Module Content: • Introduction and orientation - Medical relevance and regenerative medicine

• Cell biology - revision of cell structure, cell growth, proliferation and differentiation, cellular communications; tissue dynamics, cell adhesion.

• Mechanical forces on cells, cellular structure and mechanics, interaction with the extra-cellular matrix

• Fundamentals of stem cell tissue engineering

• Scaffolds for tissue engineering applications - design criteria, materials and fabrication techniques

• Collagen

• 3D printing and additive manufacturing

• Bioreactors for tissue engineering - Suspension Cell Cultures; perfusion bioreactors, airlift reactors, hollow fibre reactors, Micro encapsulation. Anchorage dependent cell cultures, cell retention, micro carrier STR; fluidized bed bioreactor, packed bed bioreactor. Bioreactor operation modes. Kinetics of cells culture. Influence of environmental and physiological conditions on rate equations, cell densities. cell growth and death.

Case studies

• Bioengineering of human skin substitutes

• Cartilage tissue engineering

• Bone tissue engineering

• Tissue engineering and artificial organs

Many aspects of the course will be discussed with reference to the regulations for safe handling and manufacture of materials from human cells.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to demonstrate:
• (Knowledge and understanding): A comprehensive understanding of the current applications and state of the art within tissue engineering. The design and analysis of scaffolds and bioreactors used in tissue engineering. The basic processes controlling cell division and differentiation; the structural properties of biological cells. The role of kinetics, mass transfer and materials balancing in scaffold and bioreactor design. (Evaluated in assignment and exam; SM1 SM2 SM3)
The application of engineering principles to biological systems.

An ability understand and communicate between the diverse disciplines that encompass tissue engineering for problem diagnosis. (Evaluated in assignment and exam SM3 P1)

• (Thinking skills): Interpret data and models. Manipulate models of cell mechanics to analyse cellular interactions with engineered matrices and processes within a bioreactor. Recognise the methods that will allow the successful design and analysis of those systems. (Evaluated in exam; EA1-4; SM3)

Assess health, safety and ethical issues required for the use of human cell culture and tissue engineering, and to be able to assess the relevant EU and UK regulatory framework. (Evaluated in assignment; D2 EL5 and EL6)

• (Key skills): To formulate models and carry out calculations. Critically assess design criteria for equipment selection. Logically analyse performance. (Evaluated in exam EA1-4)

Assessment:	Examination (80%) Coursework 1 (10%) Coursework 2 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Written examination (80%)

Coursework 1 Journal Paper Critique (10%)

Coursework 2 Report on Ethics,Safety and Regulation in Tissue Engineering (10%)

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: The marks of the continual assessments will be given to the students with a written description of their performance and how it could have been improved.

Optional office surgery towards the end of term specifically timetabled for individual discussuion and feedback on the course.

The students will have the standard College of Engineering feedback from the exam with a diagnostic description of each answer provided by the student cohort. This will include identification of common errors and shortfalls in the answering of the question, description of good and poor answers and recommendations as to how answers could have been improved.

Failure Redemption: Taught Masters students are only permitted to redeem a failure as per University regulations for taught masters students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes:

Available to visiting and exchange students

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

Notes, useful journal publications and past papers for this module can be found on Canvas.

EG-M328 Implant and prosthetic Technology

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CJ Wright, Dr F Zhao

Format: 15 Hours Lectures
5 Hours Tutorial
75 Hours directed learning
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method:

On campus lectures

Module Aims: This module looks at medical devices implanted within the human body and prosthetics, from two perspectives; i) how to engineer devices/implants to best deliver the required biological function and ii) the impact of implants on the human body.

Module Content: Module content: This module looks at medical devices implanted within the human body and prosthetics, from two perspectives; i) how to engineer devices/implants to best deliver the required biological function and ii) how to deal with the impact of implants on the human body.

The module will first consider the following areas before looking in detail at several specific case studies:
• Immune response to implants and prevention of rejection.
• Biofilms - prevention/control of infection.
• Biocompatibilility, biomaterials (eg using PEG to prevent non-specific protein adsorption).
• Materials considerations; structure, function and lifetime of components (inc. patterns of wear/failure mechanisms).
• Biomechanics; looking at the mechanical requirements of artificial structures, and the materials that are used to meet these requirements.
• Sterilisation methods, assessment and development for implants.

Detailed case studies include:
Biliary Stenting
Cochlear implants
Artificial hip replacement.

The module will also have the cross cutting themes regulation, procurement and commericalisation of medical devices.

Intended Learning Outcomes: Technical Outcomes
At the end of this module, you should:
• Demonstrate understand both the medical and engineering considerations that need to be made when designing medical implants and prosthetics..
• Apply mathematical concepts .(Assessed in exam SM1 SM2 SM3).
• Have knowledge of the physical principles behind implant design and operation (EA1-4, SM1 SM2 SM3).
• Appraise the design of medical implants in terms of biocompatabillity and biofilm associated malfunction, (assessed during a group project looking at procurement of implants and exam SM1 SM2 SM3).
• Draw together various pieces of basic engineering from different disciplines to design effective implants and prosthetic devices. (Assessed during a group project looking at procurement of implants and exam EA1-4).
• Have skills with the identification and understanding of regulatory frameworks (UK and EU) associated with implant design and application with consideration of the commercialisation and intellectual property constraints.(Assessed during a group project looking at procurement of implants and Exam; D2 EL5 and EL6).

Assessment:	Examination (80%) Group Work - Project (20%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: 80% Written Exam.

20% Project and Presentation.
Working in pairs the team will be allocated an implant device to research and appraise as if they are consultants advising a medical institution on the purchase and future of the relevant technology.
This coursework is conducted and assessed in groups.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: The students will have the standard College of Engineering feedback from the exam with a diagnostic description of each answer provided by the student cohort. This will include identification of common errors and shortfalls in the answering of the question, description of good and poor answers and recommendations as to how answers could have been improved.

The marks of the continual assessments will be given to the students with a written description of their performance and how it could have been improved.

An office surgery will be held to discuss progress on the course and the delivery of the project assignment.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of 100% supplementary examination.

Additional Notes:

Notes and past papers for this module can be found on Canvas.

There is a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment

EG-M332 Medical Imaging & Informatics

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof P Rees

Format: Lectures (2 hours) and interactive workshops/practical classes (2 hours) per week.

Delivery Method: This module will be delivered face-to-face using a mixture of lectures, interactive workshops/practical classes, and independent study across an 11-week teaching block.

Module Aims: The aim of this module is to introduce the science of measurement and explain the potential and the limitations of sensors commonly used in performance sports applications. Throughout the module, foundational principles will be explained using sporting examples of data analysis, with a particular focus on time-series data. A core principle of the module is that the process of measurement must be understood before applied studies are designed and data analysis is undertaken. The limits to measurement and the errors that can exist in a dataset have to be appreciated in the context of performance sport applications. The origin of the data also has to be considered as there are often hidden assumptions influencing its acquisition and pre-processing built into sensors. The aim here is to educate students about where their data comes from and to encourage them to critically assess the conditions under which valid measurements can be obtained in applied performance environments.

Module Content: • Introduction to sensors and the process of transduction - error, accuracy, precision, resolution, reliability
• Measurement units - scalar and vector quantities, units, absolute and relative measures, calibration
• Limitations to measurement - noise and drift, sensitivity and duration, averaging, noise and SNR
• Basic statistics of measurement - measurement ensembles and value distributions, mean, median, mode, standard deviation and variance
• Graphical analysis - scatter plots and data regression, interpolation and extrapolation, non-linear fitting
• Time-series data - time and frequency domain descriptions, sampling frequency and variance, basic signal manipulation
• Advanced manipulation - correlation, convolution, dynamic time warping
• Frequency analysis – Fourier transforms
• Dealing with multiple variables - dimensional reduction, PCA, stochastic neighbour embedding, cluster analysis
• Machine learning - basic concepts, ground truth, categorisation, model training, demonstration of application using decision trees
• Visualisation techniques for time series data – customisation for specific requirements of different sports
• Data Information Knowledge - understanding the differences and appreciating the wider epistemology, truth/falsehood, measures of statistical certainty, false positive and negative measurements, introduction to Bayesian statistics

Intended Learning Outcomes: On successful completion of the module, students will have the abilty to:
Critically appraise the capabilities and limitations of relevant sensors in delivering accurate and repeatable measurements.
Demonstrate an in-depth knowledge of the fundamental concepts of data analysis techniques relevant to performance science.
Use appropriate analytical approaches in the interpretation of diverse data sets and information.
Research and assess theories, principles, concepts and data, and apply such skills creatively to problem solve.
Accurately analyse and interpret data from real-world performance tests.
Effectively communicate the findings clearly and precisely to a range of audiences.

Assessment: Report (50%)
Report (50%)

Assessment Description: Coursework 1: Timed data analysis and coach report (3 hours) 50%
Coursework 2: Application of analytics to performance science Report (2000 words)

Moderation approach to main assessment: Moderation by sampling of the cohort
Assessment Feedback: Coursework 1 - Students will receive written feedback on their report within 3-weeks. Coursework 2 - Students will receive written feedback on their final submission within 3-weeks
Failure Redemption: Students can redeem a failure via re-assessment on the failed element in a re-sit period.
Additional Notes: The Faculty of Science and Engineering has a ZERO TOLERANCE policy for late submission of coursework, unless extenuating circumstances have been approved.

EG-M83 Simulation Based Product Design

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Dr B Morgan

Format: Lectures 6, Computer Lab 20, Reading/Private Study 20, Preparation for Assessment 54

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Lectures and Computer Laboratory sessions will be delivered on campus.

Module Aims: This module provides an overview of the role that simulation can play in the design process of a product. A series of lectures introduce computational modelling and the computational tools and techniques employed in the design process. The application of simulation in the design of a number of industry based research projects is presented. Computer workshops lead students in using simulation tools and applying the tools in the optimisation of the design of a product.

Module Content:

• Introduction to computational modelling and the use of simulation in the design process: Examples, advantages, disadvantages.
• Information about commercial packages for each stage of the design process.
• Overview of steps involved in the modelling process; Identification of the physics involved, The effect of problem simplifications and assumptions on the solution, Determining an appropriate analysis type, The importance of validation.
• Introduction to steps involved in computational modelling, CAD and meshing: Examples of common problems associated with these stages of the design process and techniques to avoid them; importance of solution mesh independence, Solution procedures, simulation solver software, Post-processing, Interpretation of results, visualisation and optimisation,
• Introduction to software tools used in this module, CAD, meshing, analysis and visualisation packages.
• Analysis techniques: Overview of finite difference, finite volume and finite element methods, their advantages and disadvantages, and common applications for each method type.
• Case studies: application of the knowledge gained during the lectures to a) investigate the importance of solution mesh independence and b) optimise the design of a product using simulation.

Intended Learning Outcomes:
Technical Outcomes
On completion of this module the student will:
- Have the ability to apply computer-based models for solving problems in engineering and recognise the factors that influence model limitations. Assessed using Assignment 1 and 2.
- Demonstrate the ability to develop and apply a test strategy to produce an optimised design. Assessed using Assignment 2.
- Demonstrate an understanding of the modelling process and the role of simulation in design. Assessed using Assignment 2.

Accreditation Outcomes (AHEP):

MEng:
- Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve engineering problems and implement appropriate action (EA3m)
- A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations (SM5m)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)

MSc:
- Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations (EA6m)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D9m)
- Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D10m)

Assessment:	Assignment 1 (20%)
	Assignment 2 (80%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description:
• Assignment 1: Mesh Sensitivity Study.This is an individual piece of coursework.This coursework will involve the investigation of the influence of mesh dependence, convergence criteria and physical phenomena on a simulation solution. The results of the investigation will be presented in a written report (maximum of 15 pages).
• Assignment 2: Design Optimisation. This is an individual piece of coursework.This coursework will require the student to use simulation tools to optimise the design of a component subject to given criteria.The student will also be required to show their understanding of the role that simulation plays in the design process using examples presented within the module.This coursework will be presented in a written report (maximum of 20 pages).
• Supplementary Coursework.This is an individual piece of coursework. This coursework will require the student to use simulation tools to investigate and optimise the design of a given device. This coursework will be presented in a written report (maximum of 20 pages).

Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort

Assessment Feedback: Individual written feedback will be given using Canvas. An overall assessment of the cohort's performance for the coursework will also be published on Canvas.

Failure Redemption: A supplementary piece of coursework will be set which will form 100% of the mark. This assessment will cover the learning outcomes of both coursework 1 & 2.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available for visiting students. The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-M97 Advanced Solid Mechanics

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-262

Co-requisite Modules:

Lecturer(s): Dr C Wang

Format: 20 hours lectures/20 hours computer labs (an assignment), 10 hours tutorial/office hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

20 hours of lectures/practical FEA
10 hours of tutorials/ office hours
70 hours of directed private study

Module Aims: This module covers material that is important to Engineers when working in an advanced design environment where non-linear effects such as large displacement, plasticity, creep, fatigue and bolted joint mechanics are to be considered.

Module Content: • Plasticity - post-yield stress-strain constitutive relations, development of the plastic zone, plastic bending and torsion, plastic buckling and collapse, residual stresses, spring back, low cycle fatigue
• Creep - stress-strain constitutive relations, Norton-Bailey and other creep laws, analysis of creep problems, stress redistribution, plasticity-creep interaction
• Large displacement analysis - curved beams, gross deformation
• Analysis of bolted and welded joints - bolt pre-tension, load distributions, strength and analysis of welded joints
• Codes of Practice - pressure vessels, corrosion and thermal effects, linearisation of point load stresses
• Non-linear finite element analysis - material behaviour models, incremental analysis, examples

Intended Learning Outcomes:
Technical Outcomes
- A knowledge and understanding of advanced theories associated with non-linear material and component behaviour; plasticity, creep and large displacements and how such behaviours are numerically modelled within a finite element code.
- An ability to apply these advanced theories to practical problems such as plastic bending and torsion, residual stresses and spring back, plastic buckling and low cycle fatigue.
- An ability to use finite element analysis for predicting the non-linear behaviour of components and structures and to interpret the predictions in a meaningful way.
- A knowledge and understanding of design codes of practice applied to such components as pressure vessels and piping structures.

Accreditation Outcomes (AHEP)
Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems (EA4m)
Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of engineering problems (SM2m)
Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)

Assessment: Examination 1 (80%)
Assignment 1 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Written Exam 80% Individual assignment based on a study of non-linear FEA 20%.
Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit
Assessment Feedback: Written feedback on the individual report. The Faculty of Science and Engineering uses a standard Faculty exam feedback form posted on an intranet site.
Failure Redemption: A supplementary examination will form 100% of the module mark
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Notes, worked examples and past papers for this module can be found on Canvas. Not available to visiting and exchange students.

EGIM16 Communication Skills for Research Engineers

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr SA Rolland, Dr T Lake

Format: Lectures (15h), Exercises (15h), Reading / Private Study (30h), Preparation for Assessment (40h)

Delivery Method: The module will be delivered on campus and partially online.

Module Aims: Communication at a research level differs from that at the undergraduate level in that it is usually driven by an output or result rather than the requirement to show knowledge or understanding. The skill of a good communicator at research level lies in efficiently and rigorously conveying the ideas behind the theory and proof of the research output. Verbal, written and visual communication will be explored through a series of lectures and formative exercises.

Module Content: Background to Communication:
• Academic misconduct and research publication ethics.
• Fundamentals of communication.
• Critical thinking in research.

Written Communication:
• The usual layout of reports, theses, journal & conference papers.
• How to write a good abstract for a research output.
• What should be in the introduction?
• Contents of the main body of a research output.
• Effective conclusions
• Writing style
• Cross-referencing, captions, references
• Critical review of self and others
• Design concepts for research posters

Oral Communication:
• The usual layout of a research presentation
• Slide design for a research presentation
• Delivery of a presentation
• Audience engagement.

Intended Learning Outcomes: Technical Outcomes:
By the end of this module the student will be able to:
• Write a paper or equivalent employing the structure and rigour required at research level (assessed by assignments 1 and 4)
• Efficiently communicate the concepts associated with complex ideas (assessed by the first written assignment and the oral presentation)
• Critically evaluate a written output (assessed within the second assessment component)
• Verbally present a complex idea using the presentation structure, slide content and delivery techniques expected of a research engineer (assessed through the oral presentation)

Accreditation Outcomes (AHEP)
- Awareness of the need for a high level of professional and ethical conduct in engineering (EL8M / ET1fl)
- Awareness that engineers need to take account of the commercial and social contexts in which they operate (EL9M / ET2fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9M / EP2fl)

Assessment: Assignment 1 (30%)
Oral Examination (50%)
Writing (20%)

Assessment Description: The first sit assessment will consist of 3 assignments.

The first assessment component will be a written piece, which will test the students' understanding of the literature-based research process, test their ability to articulate the findings, and draw relevant, well-supported conclusions. This is an individual piece of coursework. This assignment is a precursor to assignment 3 (article).

The oral examination will involve the students presenting the outcome of their chosen research topic (literature-based only, no original research requirement in the module), through an oral presentation. The target duration of the oral presentation will usually be between 8 to 10 minutes. The exact duration will be specified in the assignment descriptor. This is an individual piece of coursework.

The final, third, component will require the student to write a technical article or equivalent. This paper will be between four to five pages in length and will be written to a format described in the assignment descriptor. This is an individual piece of coursework.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

The reassessment will consist of 2 assignments, detailed in a further section.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: CANVAS will be used to provide individual feedback to the students on all the components that contribute to the final mark. For the first assessment component a class feedback document is also generally included on CANVAS.

As part of the practical sessions the students will receive verbal feedback on their performance. These sessions do not contribute to the final mark.

Failure Redemption: Candidates shall be given one opportunity to redeem a failure in the module during the summer supplementary period.

In addition, the 40 % oral and written assignments of the first must be passed individually to pass the module, and will have to be redeemed even if a pass mark is achieved for the module overall on first sit. A pass mark on both main assessment components will be required to pass the module.

All components are redeemable individually in the event of failure across the module. Students may be required to take supplementary examination of examined components they have already passed if the combination of marks is such that the module may be failed.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

All lectures and course material will be provided on CANVAS.

The pass mark for a module at Level 4/M is 50%. In addition to this Students must achieve at least 40% in the Oral Examination AND 40% in the Writing assessment to pass the module.

The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EGM403 Implant Engineering 2

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EGA308

Co-requisite Modules:

Lecturer(s): Dr S Sharma, Dr CJ Wright

Format: 20 Hours Lectures
5 Hours Tutorial
Site Visit
75 Hours directed learning

Delivery Method: On campus

Module Aims: This module is an advanced look at the design, fabrication and optimisation of medical implants and prosthetics. Case studies will be used to bring together engineering concepts and apply them to key devices that are used to treat disease and assist patients.

Module Content: This module will examine in depth the following areas before looking in detail at several specific case studies;

Lectures

• The material properties that are important to optimise function of the implant.
• The mechanical relationship between the implant and the system it is integrated into Biomechanics of the tissues associated with implants.
• The response of the body to different materials implanted or associated with the human body.
• Modification and coating of implant surfaces for optimisation.
• Characterisation and monitoring of the medical device performance.
• Regulation of implant device fabrication and application.
• The business of implant and prosthetics.
• Advanced function and control of the medical device.
• Ethics and human augmentation.

Detailed case studies

• Rehabilitation engineering and assistive technology.
• Skin

Practical
• Solid works and other software will be used to design an implant device, which will be 3D printed as a prototype.
• Materials testing of key implant substrates.

Intended Learning Outcomes: Technical Outcomes
• Knowledge and understanding of the application of engineering principles to the design fabrication and optimisation of medical implants and prosthetics.(Assessed in Project and Exam)
• Knowledge and understanding of biocompatibility and impact of implants and prosthetics on the human body (Assessed in Project and Exam).
• Practical skills; Mechanical testing methods and how to handle specific materials used in manufacturing of medical implants and prosthetics. Experience of the medical design process from inception to prototype fabrication through 3D printing and other fabrication methods. (Assessed in Project)
• Knowledge and understanding of regulation of implant device fabrication and application and how to decipher the jargon and language style of regulatory documentation. (Assessed in Project)
• An appreciation of the future direction of implants and prosthetics and the demands this will have on a future career within medical engineering.

Accreditation Outcomes
- A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1m)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- Awareness of developing technologies related to own specialisation (SM4m)
- Understanding of concepts from a range of areas including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects (SM6m)
- Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes (EA1m)
- Ability to use fundamental knowledge to investigate new and emerging technologies (EA5m)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1)
- Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards (D2)
- Apply advanced problem-solving skills, technical knowledge 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 (D4)
- Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations (D7)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (EL2)
- Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate (EL4)
- Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally (EL5m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (P1)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Understanding of the use of technical literature and other information sources (P4m)
- Understanding of appropriate codes of practice and industry standards (P6)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints (P10m)

Assessment:	Examination (75%) Project (25%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: 75% written exam

25% Project and presentation. Working in pairs the team will be allocated an implant device to research and appraise as if they are consultants advising a medical institution on the purchase and future of the relevant technology.
This coursework is conducted and assessed in groups.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: The students will have the standard Faculty of Science & Engineering feedback from the exam with a diagnostic description of each answer provided by the student cohort. This will include identification of common errors and shortfalls in the answering of the question, description of good and poor answers and recommendations as to how answers could have been improved.

The marks of the continual assessments will be given to the students with a written description of their performance and how it could have been improved.

An office surgery will be held to discuss progress on the course and the delivery of the project assignment.

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

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Notes and past papers for this module can be found on Canvas.

The Faculty of Science & Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EGNM05 Bio-nanotechnology

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CJ Wright

Format: 20 Hours Lectures
5 Hours Tutorials
75 Hours Directed Learning
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Module Aims: The module aims to equip the student with an understanding of the concepts behind bionanotechnology. To achieve this the student is introduced to the relevant biological processes that control life with nanoscale systems. This knowledge is established from the perspective of nanoscale engineering.

Module Content:

• Introduction to the course and orientation
• Biological Systems relevant to nanotechnology - Biological hierarchy; carbohydrates; lipids; proteins; nucleic acids (DNA, RNA); protein synthesis; recombinant DNA techniques;
• Characterisation of biomedical surfaces at the nanoscale.
• Introduction to Colloidal systems - Nature of the colloid state
• Bio-nanocomposites
• Bio-sensors application within engineering, medicine and environment.
• Nanoscale properties of the mammalian and microbial cell interface.
• Regenerative medicine at the nanoscale.
• Appropriate health and safety issues will be covered.
• Current bionanotechnology case studies.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to demonstrate:
• A knowledge and understanding of how and why modern research is harnessing biological systems to further nanotechnology endeavour.
• How modern engineering is gaining guidance from natural systems that construct and control at the nanoscale.
• How general principles of structure and function within biological systems are used to construct functional devices within nanotechnology.
• The techniques that are available for characterising, harnessing and modifying these nanodevices.
• Current applications and state of the art within biotechnology
• Current realistic speculation as to the future of biotechnology
• An understanding of health and safety aspects of nanotechnology and its impact on the natural and built environment
• An ability to understand and communicate between the diverse disciplines that encompass bionanotechnology.

Accreditation Outcomes (AHEP)
• A comprehensive understanding of the relevant scientific principles of the specialisation (SM1fl)
• A critical awareness of current problems and/or new insights most of which is at, or informed by, the forefront of the specialisation (SM2fl)
• Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects (SM3fl)
• Ability to use fundamental knowledge to investigate new and emerging technologies (EA2fl)
• Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods (EA3fl)
• Awareness of relevant regulatory requirements governing engineering activities in the context of the particular specialisation (ET5fl)
• Advanced level knowledge and understanding of a wide range of engineering materials and components (EP1fl)

Assessment:	Examination 1 (60%) Coursework 1 (10%) Coursework 2 (25%) Presentation (5%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description:
• Examination 60%
• Paper Critique 10%
• Project 25%
• Project presentation 5%

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 40% in the examination component, and a minimum of 50% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 50%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: The marks of the continuous assessment will be given to the students with a written description of their performance and how it could have been improved..

There will be an office surgery for students to discuss performance in module and progress on the project

The students will have the standard Faculty of Science and Engineering feedback from the exam with a diagnostic description of each answer provided by the student cohort. This will include identification of common errors and shortfalls in the answering of the question, description of good and poor answers and recommendations as to how answers could have been improved.

Failure Redemption: If rules allow - standard University provisions with marks capped. Failure redemption would be by project, that will cover all aspects of the module syllabus. The project will be designed to allow the student to demonstrate their level of knowledge and understanding of the module and synthesis with their course and wider context of study.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

• All lectures and Course Material will be provided on Canvas.

• This is a masters level module thus students are expected to demonstrate independence of study and thought, actively reading around the topic to cope with any shortfalls in their previous experience.

• The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment

EGNM07 Principles of Nanomedicine

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Sharma, Prof OJ Guy

Format: 20 hours of formal lecturing. 40 hours private study/reading and 40 hours preparation for assessment

Delivery Method: 100% course work

Module Aims: This module will cover the broad range of subjects which encompass the discipline nanomedicine. Building on the foundation of a knowledge of nanotechnology this module will focus on medical applications including biological markers, diagnostics, therapeutics and drug delivery vehicles.

Module Content:

- Interactions on the nanoscale: biological, physical, chemical and optical interactions.
- Nanoparticles: optical markers, magnetic markers - dots, tubes, wires etc.
- Drug delivery strategies: drug delivery systems, pharmacology of nanovectors.
- Imaging techniques: Microscopy, Flow cytometry.
- Therapeutics: thermal, optical, microwave.

Intended Learning Outcomes: Technical Outcomes
• An understanding of the physics at the nanoscale together with an appreciation of the relevant biology of the system studied.
• How to design and fabricate a nanoparticle marker.
• An understanding of nanoscale imaging techniques and their limitations.
• An appreciation of how a nanoparticle can be used as a drug delivery vehicle.
• A knowledge of medical practices, diagnosis and treatment
• Study independently; use library resources; note taking; time management

Accreditation Outcomes (AHEP)

MEng
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline and the ability to evaluate them critically and to apply them effectively (SM3m)
- Awareness of developing technologies related to own specialisation (SM4m)
- Understanding of concepts from a range of areas including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects (SM6m)
- Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D3m)
- Understanding of the need for a high level of professional and ethical conduct in engineering, a knowledge of professional codes of conduct and how ethical dilemmas can arise (EL1m)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk (EL6m)
- Knowledge of characteristics of particular equipment, processes, or products, with extensive knowledge and understanding of a wide range of engineering materials and components (P2m)
- Understanding of the use of technical literature and other information sources (P4m)
- Ability to work with technical uncertainty (P8m)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (P9m)
- Apply their skills in problem solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)

MSc
- Understanding of concepts relevant to the discipline, some from outside engineering, and the ability to evaluate them critically and to apply them effectively, including in engineering projects (SM3fl)
- Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D1fl)
- Awareness of the need for a high level of professional and ethical conduct in engineering (ET1fl)
- Awareness of and ability to make general evaluations of risk issues in the context of the particular specialisation, including health & safety, environmental and commercial risk (ET6fl)
- A thorough understanding of current practice and its limitations, and some appreciation of likely new developments (EP2fl)

Assessment:	Coursework 1 (25%) Coursework 2 (25%) Coursework 3 (25%) Coursework 4 (25%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: The continuous assessment will be based on a literature survey and a series of problem sheets relating to scientific journal papers and class room lectures.

Courseworks C1, C2 and C3 will be done individually. C4 will involve group presentations.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Individual feedback on each piece of assessed work via Canvas or can be discussed via Zoom, Skype or in person.
Failure Redemption: If rules allow - standard University provisions with marks capped. Any re-examination of this module will be by 100% coursework submission.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. • AVAILABLE TO Visiting and Exchange Students. The module has no pre-requisites.