DEPARTMENT OF BIOMEDICAL ENGINEERING

University of Strathclyde Engineering

MSc and Postgraduate Diploma Courses

in Biomedical Engineering

Student Handbook

Session 2023 – 2024

WELCOME

From the Head of Department

Dear all

On behalf of the Department of Biomedical Engineering and the Faculty of Engineering, I would like to offer a warm welcome to the Department of Biomedical Engineering and the University of Strathclyde.

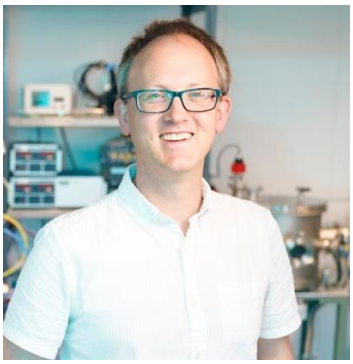
You are joining one of the longest established Departments of Biomedical Engineering in the world, a department that has been at the forefront of teaching and research in Biomedical Engineering and Prosthetics and Orthotics for over 60 and 50 years respectively. Our teaching programmes are multi-accredited and the department's staff do their utmost to ensure that all of our students are supported in every way possible throughout their studies. Our courses are strong on education, but we hope enjoyable and relevant to the aspirations of the modern Biomedical Engineering or Prosthetics and Orthotics student in pursuing a career in this exciting field.

As new postgraduate students, you also have your part to play in the success of your course and Department. The course team has put together an exciting curriculum, spanning the field of biomedical engineering, and I ask that you apply yourself to your studies with energy and enthusiasm. Wherever you go, you are now representatives of the Department of Biomedical Engineering and the University of Strathclyde.

Our Wolfson Centre underwent a complete renovation and upgrade a couple of years ago – to keep Biomedical Engineering at Strathclyde at the forefront of biomedical teaching and research for the next 60 years and beyond. We are delighted in having you join us in these revamped facilities. Our clinical teaching facilities for prosthetics and orthotics are located in the Curran Building, which also underwent a number of renovations this summer ahead of the 23/24 semester start.

As you transition to Strathclyde University, you will be required to do a lot more independent learning, which necessitates good time management and motivation. You may be living away from home for the first time which also brings new financial independence and responsibilities. If you feel that you are struggling in any way please come and talk to the course director, or one of the other departmental staff, and we will do all we can to help.

We are delighted to have you join us.



Professor Stuart Reid FRSE
Head of Department
Department of Biomedical Engineering

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THE DEPARTMENT OF BIOMEDICAL ENGINEERING

The Department of Biomedical Engineering, in the Faculty of Engineering, was formed in 2012 following the merger of the Bioengineering Unit and the National Centre for Prosthetics and Orthotics. The merger reconnects two complementary and key areas of health technology teaching and research within the University. The single department offers student's unrivalled undergraduate and postgraduate opportunities for learning and knowledge exchange in prosthetics and orthotics and for advanced postgraduate study in a broad range of biomedical engineering disciplines.

The Bioengineering Unit was established 50 years ago and is an internationally-recognised centre of excellence for postgraduate education and research at the interface between engineering and the life sciences, with particular emphasis on clinically-related research. The goal of the Unit is to transform and improve future healthcare through innovations and advances in science in technology.

The MSc/PgDip is predominantly taught by the Bioengineering Unit in the Department of Biomedical Engineering. The following Biomedical Engineering staff, with their contact details, have a significant role on the course. Other staff, including those from other departments, may also contribute to the course in a minor capacity, and their contact details will be given by them in due course.

HEAD OF DEPARTMENT	E-mail	Extension
Prof Stuart Reid	stuart.reid@strath.ac.uk	3137
COURSE DIRECTOR		
Dr Asimina (Melina) Kazakidi	asimina.kazakidi@strath.ac.uk	3228
DEPUTY DIRECTOR and ADVISOR OF STUDIES		
Dr Mairi Sandison	mairi.sandison@strath.ac.uk	3030
COURSE ADMINISTRATOR		
Ms Gillian Boyd	gillian.boyd@strath.ac.uk	3143
COURSE TEACHING STAFF		
Dr Arjan Buis	arjan.buis@strath.ac.uk	4716
Dr Craig Childs	craig.childs@strath.ac.uk	2228
Dr Peter Childs	peter.childs@strath.ac.uk	3114
Dr Mario Giardini	mario.giardini@strath.ac.uk	3042
Dr Danial Kahani	danial.kahani@strath.ac.uk	4659
Dr Melina Kazakidi	asimina.kazakidi@strath.ac.uk	3228
Dr Andy Kerr	a.kerr@strath.ac.uk	2855
Dr Michelle MacLean	michelle.maclean@strath.ac.uk	2891
Dr Christopher McCormick	christopher.mccormick@strath.ac.uk	3438
Dr Helen Mulvana	helen.mulvana@strath.ac.uk	3842
Dr Philip Riches	philip.riches@strath.ac.uk	5703
Prof Stuart Reid	stuart.reid@strath.ac.uk	3137
Prof Philip Rowe	philip.rowe@strath.ac.uk	3032
Dr Craig Robertson	craig.a.robertson@strath.ac.uk	2005
Dr Mairi Sandison	mairi.sandison@strath.ac.uk	3030
Dr Junxi Wu	junxi.wu@strath.ac.uk	2505
Dr David Li	david.li@strath.ac.uk	3431
DEPARTMENT DISABILITY CONTACT		
Ms Gillian Boyd	gillian.boyd@strath.ac.uk	3143

OVERVIEW OF THE MSC/PGDIP BIOMEDICAL ENGINEERING

MSc and PgDip students are required to undertake instructional classes and complete a research project. For the MSc degree, students must attain 120 credits from the instructional classes and obtain a further 60 credits on satisfactory completion of a thesis on a research project. PgDip students are required to attain 120 credits in total, either in totality from the instructional classes, or including a further 20 credits on satisfactory completion of a dissertation.

In the 1st week of the course, you will be interviewed by a member of senior staff who will advise you on the classes you should attend. The list of classes is given on page 6. The selection of classes in Block 1 will reflect your previous education. For example, physical science students will normally take the Medical Science conversion module, while life science students will normally take the Engineering Science conversion module.

Midway through Semester 1, a list of available research projects will be published. You should speak with project supervisors about the projects that you are interested in and submit a form indicating your 1st, 2nd and 3rd. Projects will be allocated at the start of semester two.

There are two examination weeks before the Winter break. Semester 2 starts mid-January after a consolidation week. There are two weeks of vacation in Spring, and examinations are held after this break.

Prior to week 11 of Semester 2 you are required to submit an abstract of your MSc project. In mid-July, you will be required to make an oral presentation of your MSc project, outlining the programme of research you have undertaken and your key findings. Your project supervisor will advise you on the preparation of the abstract and oral presentation.

Second semester classes will be examined in April-May and following this, a meeting of the Board of Examiners will be held at which the performance of each student during Semesters 1 and 2 will be reviewed and progress recommendations based on the student's examination results made.

MSc students who attain at least 120 credits will be allowed to proceed as normal. Those who do not attain 120 credits may on the basis of their performance be: (i) instructed to undertake resit examinations, (ii) advised to transfer to the Diploma course or (iii) required to terminate study (please see the following section on compensation schemes and resit examinations for detail).

Resit examinations will be held in August. The format of the resit will be as stated in the individual module descriptors or as communicated by the module coordinator.

Following the completion of project work, PgDip students submit a dissertation (typically a review of the literature), while MSc students are required to submit a thesis. The submission date for MSc students will be in early August. MSc students will be required to attend an oral examination of their thesis in mid-late August, and present their research as a Poster to the examiners. PGDip students will be required to submit their dissertation in mid-July.

Whilst every effort has been made to make this handbook correct at the time of production, please be aware that some information may be subject to revision. Any changes will be communicated to you in advance, so please ensure that you keep up to date with your Strathclyde email messages and communications posted to you via Myplace.

CLASSES IN THE MSc/PgDip BIOMEDICAL ENGINEERING

Code	Class Name	Semester	Credits	Organiser
Initial Classes (one of):				
BE915	Medical Science for Engineering	1	20	Dr Junxi Wu
or				
BE911	Engineering Science	1	20	Dr Chris McCormick
Compulsory (for MSc) Classes:				
BE918	Professional studies in Biomedical Engineering	1	10	Dr Craig Robertson
BE919	Research Methodology	1	10	Dr Chris McCormick
BE909	Biomedical Electronics	2	10	Dr Mario Giardini
BE908	Biomedical Instrumentation	1	10	Dr David Li
Optional Classes (6 to be taken for MSc):				
BE916	Introduction to Biomechanics	1	10	Prof Phil Rowe
BE902	Prosthetics and Orthotics	2	10	Dr Arjan Buis
BE901	Regenerative Medicine and Tissue Engineering	2	10	Dr Peter Childs
BE900	Tissue Mechanics	1	10	Dr Phil Riches
BE904	Clinical and Sports Biomechanics	2	10	Dr Andrew Kerr
BE905	Biosignal Processing and Analysis	2	10	Dr David Li
BE912	Anatomy and Physiology	2	10	Dr Chris McCormick
BE906	Biomaterials and Biocompatibility	2	10	Dr Chris McCormick
BE903	Cardiovascular Devices	1	10	Dr Craig Robertson
BE920	The Medical Device Regulatory Process	2	10	Dr Craig Robertson
BE923	Haemodynamics for Engineers	2	10	Dr Asimina Kazakidi
BE924	Medical Robotics	2	10	Dr Will Shu
BE925	Numerical Modelling in Biomedical Engineering	2	10	Dr Asimina Kazakidi
BE928	Rehabilitation Technology	2	10	Dr Andrew Kerr
Independent Research Classes:				
BE907	MSc Project	1, 2 and 3	60	Dr Chris McCormick
or				
BE914	PgDip Biomedical Engineering Dissertation	3	20	Dr Asimina Kazakidi

A detailed description of each class is provided in the section on Module descriptors.

GENERAL NOTES

Wolfson Building Access

The normal hours of access to Wolfson Building are: **Monday to Friday 0800 to 1800 hours**

Every other time is considered out-with normal working hours. Saturdays, Sundays and public holidays are considered to be out-with normal hours of access. Out of hours IT provision is available in the library.

You are not allowed in the building at any other time, except with a valid out of hours access card. An out of hours access card (RED), issued by the Department Administrator, allows access to low hazard areas only. It must be signed by the Head of Department, or their deputy and the person being granted access. These RED cards are **not** normally provided to MSc/PgDip students.

Under no circumstances are you to invite friends or family into the building without the prior approval of the Head of Department.

Health & Safety
University Health and Safety information may be found here: http://www.strath.ac.uk/wellbeing/

Essential departmental Health and Safety policy is:

Emergency evacuation of buildings
If you discover a fire:
1. raise the alarm by operating the nearest fire alarm 'break-glass' call point.
2. leave the building by the nearest escape route

When you hear the fire alarm:
1. Evacuate the building immediately using the nearest escape route
2. Do not delay your departure by collecting personal belongings
3. Where possible, close all doors through which you pass
4. Once outside, proceed to the designated assembly point
5. Do not use lifts during a fire alert
6. Do not re-enter the building until advised by University Security Staff or Safety Services staff

Familiarise yourself with the emergency routes from the building and the location of fire alarm call points and fire-fighting equipment. This will improve your response in the event of an emergency.

Procedure for summoning first aid assistance
In the event of an accident:

- All University Security staff are qualified to administer first aid. To summon assistance, telephone Security Control on emergency number 2222. If phoning from a mobile – 0141 548 2222.
- State your name, department and the telephone extension from which you are calling.
- Give your location and brief details of the casualty's injuries.
- If you consider the injuries are sufficiently serious to warrant hospital treatment, inform Security Control that an ambulance is required.
- Remain with the casualty until the arrival of the first aider who will take charge of the situation.

Ring x3333 for advice and non-emergency assistance. In a student residence, ring 8888 for assistance. Security Control can be found on the ground floor of the Livingstone Tower and is staffed 24 hours a day, 7 days a week.

Before participating in laboratory sessions, each student should have read and become familiar with the Departmental Safety Regulations. A copy of these regulations will be provided. Before research projects commence, all students must attend a Safety Talk organised by the Department and complete all necessary safety documentation, including completion of a training record.

The Departmental Safety Officer is Katie Henderson, extension 3867 or 0141 548 3867.

Communication
Students must notify the Department and University of any change in their in-term or out-of-term addresses. The University may use these addresses for official communications and cannot be held responsible for non-delivery where a change of address is not notified.

The Department of Biomedical Engineering and the University will predominantly communicate with students using their Strathclyde email account. It is students' responsibility to check this email account daily for new Departmental and University messages.

Individual class lecturers and tutors may use the University's virtual learning environment (MyPlace) to communicate class matters to students (http://classes.myplace.strath.ac.uk/). It is the students' responsibility to ensure that they are able to engage with this environment as expected by individual tutors. Online training packages are available. Class tutors will require assignments to be uploaded to MyPlace for assessment purposes, with Turnitin, a plagiarism detection software being used where appropriate.

Smoking
The University has a policy on smoking. This is available from:

www.strath.ac.uk/wellbeing/lifestyle/smoking/

Smoking is prohibited within all University buildings and within 15 feet (4.6m) of any University building entrance, doorway, stairway or covered area.

You are also asked to take a responsible attitude to ensure that areas are kept litter free and that you do not stand in close proximity to open windows.

Eating and Drinking Areas
Eating and drinking are permitted in the office areas and the social area only. Eating and drinking are not permitted in any labs, prosthetic or mechanical/electronic workshops.

Use of Computing Facilities
Your attention is drawn to the University Regulations regarding the use of computing facilities, which can be found at:
Find and use IT or AV | University of Strathclyde

Library_&_IT_student_guide_-_web_-_September_2022_update.pdf (strath.ac.uk)

Equality and Diversity
The University of Strathclyde is committed to achieving and promoting equality of opportunity in the learning, teaching, research and working environments.

We value the diversity of our students and support the development of mutual respect and positive relations between people.

The University has in place Equality Outcomes which meet the requirements the Equality Act 2010.

You are advised to familiarise yourself with the University approach to equality and diversity and relevant developments and information by visiting the website: www.strath.ac.uk/equalitydiversity/

If you have any queries please bring these to the attention of staff or the University's Equality and Diversity office. Email: equalopportunities@strath.ac.uk Tel: 0141 548 2811

Athena SWAN
The University currently holds a Bronze Athena Swan award, recognising our commitment to advancing women's' careers in science, technology, engineering, maths and medicine (STEMM) employment in academia.

The Athena SWAN Charter has been developed by the Equality Challenge Unit to encourage and recognise commitment to combating the under-representation of women in STEMM research and academia.

If you would like any additional information, please contact the Equality and Diversity office.

Disability and Wellbeing
The University is committed to providing an inclusive learning and working environment for disabled people.

If you have, or think you have, a disability we encourage you to disclose it as soon as possible. Declaring your disability will enable you to access any additional support that you may need and help to ensure you become a successful student. The information you provide will be treated as confidential and will not be shared with other staff without your consent.

The University has a dedicated Disability Service that offers specific advice, information and assistance to disabled students, including information on the Disabled Students Allowance (DSA). Further information is available from the website:

www.strath.ac.uk/professionalservices/disabilityandwellbeing/

In addition, each academic Department/ School (for HaSS) has at least one Departmental Disability Contact (DDC), who act as a first point of contact for disabled students. The Departmental Disability Contact list is available on the website at:

www.strath.ac.uk/professionalservices/disabilityandwellbeing/contact/

Please inform your course director, the DDC (Ms Gillian Boyd, gillian.boyd@strath.ac.uk) and a member of the Disability Service of your needs as soon as possible. The Disability Service will then formally communicate your needs to your Department/School.

Email: disability-wellbeing@strath.ac.uk Tel: 0141 548 3402

Issues with Physical Access on campus
If you experience an issue with physical access anywhere on campus, please email: physicalaccess@strath.ac.uk where a member of Estates staff will be able to help.

Classroom Protocol
At the University we are committed to providing a safe learning environment where dignity is respected and discrimination or harassment, including cyber bullying does not occur on the basis of age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, sexual orientation and socio-economic background. No student should intentionally be made to feel threatened or excluded from class participation.

You are reminded of your responsibility for the duration of your studies by showing respect to fellow classmates and staff by remembering the following protocol:

https://www.strath.ac.uk/studywithus/strathlife/whatitslikestudyingatuniversity/

Departmental Disability Contact (DDC)
The designated DDC in the Biomedical Department is Ms Gillian Boyd (extension 3143, 0141 548 3143)

The role of the DDC is to discuss with students with a disability, any aspect of the courses and classes offered by the Department that might relate to their special needs with a view to ensuring, as far as possible, that any necessary adjustments are identified or sought. It is important that if you feel you require any adjustments that you discuss your needs with the DDC at the earliest opportunity.
The DDC acts as a two-way channel for communication between the University's Disability Service and academic and other staff of the agreed and disclosed needs of disabled students, with due regard to the students' rights to confidentiality.

Students with disabilities are also advised to contact the University Disability Service.

COURSE INFORMATION

Class Requirements
At the start of each class, the organiser will specify the level of skills necessary (e.g. in mathematics). Voluntary maths tuition is offered in Welcome and Development week, however further mathematical work may be required in particular classes.

Attendance at Classes
Attendance at lectures and laboratory classes is a mandatory part of the MSc course. The attendance requirements for the MSc course are 75% of lectures, and 90% of laboratory classes, unless there is a valid reason for non-attendance. Reasons for absence from classes must be explained to the class teacher, and if appropriate entered on Pegasus as personal circumstances, otherwise the student will be marked as absent. A student who does not satisfy the requirements as to attendance and performance will not be entitled to take the examinations in the class concerned. Please refer to University Regulations for PGT courses, Attendance and Performance, Section 18.1.15.

Examination Procedure
Class examination will usually be by written examination coupled with tutorial or homework assignments. Some classes require the submission of laboratory reports for assessment. The class organiser will give details of the examination procedure and dates for completion of assignments at the start of each class.

External Examiners
External examiners for the MSc/PgDip (and taught modules of the MRes) courses are Dr Paul Roach, University of Loughborough, and Professor Robert Reuben, Heriot Watt University, Edinburgh.

Assessment and Award of Credits
Every class will be marked on a percentage scale, with the pass mark for each class set at 50%. On achieving a mark of 50% or more for a class, the student is awarded the class credits. The taught curriculum consists of 120 credits with the MSc project adding a further 60 credits.

Compensation Mechanism and Resit Examinations
To proceed to the MSc project/dissertation a candidate will normally have accumulated 120 credits on the taught component of the course at the first attempt. With respect to students who have not passed all their credits at the first attempt the Board of Examiners will apply the Faculty Compensation Scheme, if applicable, as outlined below. If this can be done and the student thereby gains sufficient credits, then the student may proceed to the project.

The Faculty operates a compensation scheme that is designed to assist Boards of Examiners to take decisions about student progress to the MSc project/dissertation. The scheme can be applied only to the student's first attempts and, therefore, is normally used only at the May/June meetings of the Boards of Examiners.

After the first attempt at the 120 credit taught curriculum has been completed, students may proceed onto their MSc project provided their first attempt credit-weighted average (CWA) is 50% or more.

If a class mark is below 40%, that class must be re-examined at the August examination diet.

If a class mark is between 40% and 49%, that class may be eligible for compensation. MSc students who have attempted at least 120 credits from the course curriculum and who have CWA of at least 55% are eligible for compensation. Any combination of classes, up to a maximum of 20 credits, may be compensated. Rewarding an overall good performance, compensation means that students receive the credits for the marginally failed class and there is no requirement for additional examination. If more than 20 credits of classes are eligible for compensation, the classes with the highest marks, up to a total of 20 credits, will be compensated, and the remaining classes must be resat.

After any compensated passes have been applied, and providing their CWA is greater than 50%, students with 90 credits or fewer will be required to take their resits before commencing the project. They will be allowed to proceed with their MSc project on passing their resits. After any compensated passes have been applied, students with 100 credits or more, may ‘proceed at risk’ or they may decide to delay the start of their projects until after the resit exams.

After the first attempt at the 120 credit taught curriculum has been completed, students with 90 credits or fewer AND who have a CWA of less than 50% will be transferred to the PGDip.

PgDip students who satisfy the requirements of the MSc may be transferred to the appropriate MSc course and proceed to the project.

Students who are allowed to proceed to their MSc project with a resit examination in August will be warned that they cannot remain on the MSc course unless all outstanding taught classes are passed at the second attempt. Such students are required to sign a form verifying that they understand and accept the conditions required to remain on the MSc course.

MSc, PgDip and PgCert Awards
Where a candidate has accumulated 120 credits of taught classes from the curriculum, together with 60 credits for the project, they will be awarded an MSc.

The MSc in Biomedical Engineering can be awarded as:
MSc Biomedical Engineering;
MSc Biomedical Engineering with Biomechanics; or
MSc Biomedical Engineering with Cell and Tissue Engineering

Please refer to the Course Regulations inserted on pages 20-21 of the handbook for the modules to be studied for each of the sub-specialisations.
Note that, at present, only MSc Biomedical Engineering is IPEM accredited.

Where a candidate has accumulated 120 credits of taught classes from the curriculum (including the PgDip dissertation), but has not obtained 60 credits for the project, he/she will be awarded a PgDip.

Where a candidate has not accumulated 120 credits of taught classes after 2 attempts, he/she may be considered for a PgCert. The PgCert can be awarded if the candidate has accumulated at least 60 credits of taught classes from the curriculum.

A candidate who has accumulated less than 60 credits of taught material after two attempts will be deemed to have failed, and no award will be made.

Awards may be made “with Merit” or “with Distinction” according to the following framework. The CWA is calculated using the first attempt marks for each class, including the project.

Degree Classification	CWA (including project)
Distinction	70% – 100%
Merit	60% - 69%
Award	50% - 59%

A compensated pass is acceptable for Distinction/Merit awards, provided the overall mean score is in the Merit/Distinction category.

Late Submissions and Extensions

Extensions

Before requesting an extension, it is advised that students read this section fully. The extension request requirements vary depending on the length of extension requested and the method by which the request is submitted. There is also some guidance on what might constitute grounds for an extension request to be granted.

Students requesting an extension to the deadline for a piece of coursework must apply via the extensions tool in Myplace. Further guidance about using this tool is contained under the heading *'Myplace Extension Request'* below.

Please pay attention to the examples found under the Section 3 heading *'Grounds for Extending the Deadline for Coursework Submission'* below. These are taken from the Policy and Procedure on Extensions to Coursework Submission. The policy intends to be supportive of students, and staff will monitor students' use of extensions in order to identify students who may require support. The policy provides examples of what might be grounds for granting an extension and what is unlikely to be grounds for the granting of an extension. The list does not try to cover every possible scenario so students should discuss with staff any circumstances that are negatively impacting their studies.

Extension requests will normally be made in advance of a coursework submission deadline. In exceptional cases, students may apply for an extension retrospectively.

Extension of less than seven calendar days

Requests for an extension of less than seven calendar days do not require formal supporting evidence (e.g., a doctor's letter). However, students are encouraged to communicate to staff any circumstances that are negatively impacting their studies as early as possible, especially where other assessments or aspects of their studies are also impacted. This can be done by submitting a Self-Certificate form on Pegasus.

Extension of longer than seven days

For extensions that are longer than seven days, it is essential that students complete a 'Personal Circumstances Form' and submit it directly to Student Business for their Faculty at: studentbusiness-engineering@strath.ac.uk within five working days of the agreed extension date. There is information about the Personal Circumstances Procedure on the website.

Failure to submit evidence of medical or personal circumstances for extension requests of seven days or more could result in the extension request being rejected or revoked and/or any subsequent academic appeal being regarded as inadmissible.

Students should note that certified cases of medical and/or personal circumstances will be considered sympathetically and the rules will be applied in a caring manner. Where there are sensitivities or difficulties in obtaining evidence (for example, a death certificate), a compassionate approach will be taken. The rules are designed to be as clear as possible, to help students plan their work sensibly and ensure parity in the service provided to all students.

Grounds for Extending the Deadline for Coursework Submission

The list below does not try to cover every possible scenario but provides examples of what might be grounds for granting an extension and what is unlikely to be grounds for the granting of an extension. Students should not be discouraged from submitting a request if they do not see their situation described below.

Examples of Medical Circumstances

Medical conditions or illness, including physical and/or mental health problems that negatively impact a student's preparation for an assessment.

Examples of Personal Circumstances

- serious illness or death of a person close to the student
- family break-up
- being a victim of crime
- being in a serious car accident
- jury service
- significant relationship breakdown
- unexpected caring commitments
- homelessness
- Home Office requirements
- Fire
- flood
- adverse weather conditions
- exceptional travel circumstances out with a student's control which prevented them from meeting the published submission date
- other exceptional circumstances that can be reasonably considered to negatively impact a student's ability to submit coursework on time

Examples of Insufficient Grounds for an Extension

The following circumstances would not be acceptable grounds for granting an extension:

- poor planning and time management
- error made in understanding the published dates of assessment submissions
- having another assessment due on or around the same date
- minor IT issues such as computer failure
- failure of third parties to deliver the assessment
- holidays, social events, moving house, or any event planned in advance of the submission deadline
- failure to make alternative travel plans when disruptions were advised in advance

Myplace Extension Request Process
Instructions for the submission of an extension request via Myplace are below. A version of these instructions with images of the screen to support the explanation is also available.

1. Go to the Myplace site for the class in which you wish to request an extension to the deadline of a piece of coursework
2. Click on the assignment link for the piece of coursework. This will open a page containing information about the assignment, the status of your submission and the deadline
3. Click on the Extensions section and select 'Request Extension'
4. You will be required to fill in three parts of a form:
    i. Select a reason from the dropdown list
    ii. Propose a new deadline (date and time)
    iii. Describe in more detail your reason for requesting an extension
5. Submit your extension request

You will receive a Myplace notice and an email to confirm that your request has been submitted. If you have downloaded the University's Mobile App and have logged in using your DS username, you will also receive a push notification on your device.

Your request will be considered, resulting in one of the following two outcomes:

1. Your extension request will be granted – either based on the date and time you proposed or based on an alternative date and time specified by the appropriate member of staff
2. Your extension request will not be granted*

The outcome of your extension request will be communicated to you via a Myplace notice and an email. If you have downloaded the University's Mobile App and have logged in using your DS username, you will also receive a push notification on your device.

If you submit an extension request and decide that you no longer require it, you can cancel the request up until the point at which it is approved. After it has been approved, you cannot cancel the request but you can, of course, submit the work in time for the original deadline.

*If your extension request is not granted and you would like to access support please contact your Advisor of Studies. For details of central University support services, please see the 'Support' section below.

Support
Disability and Wellbeing Service (including Student Counselling Service and Student Health)
Phone: 0141 548 3402
Email: disability-wellbeing@strath.ac.uk
Disability & Wellbeing Service
Room 4.36, Level 4,
Graham Hills Building
50 George Street
Glasgow G1 1QE
For more information visit the Disability and Wellbeing Service webpage.

Study Skills Service
Phone: 0141 548 4064/4062
Email: studyskills@strath.ac.uk
Level 6
Livingstone Tower
26 Richmond Street
Glasgow G1 1XH
For more information visit the Study Skills Service webpage.

Learner Development Services
TL453, Prof. Mary Dunn Wing
Learning and Teaching Building
Glasgow G1 1XQ
For more information visit https://www.strath.ac.uk/studywithus/strathlife/academicsupport/

International Student Support
Phone: 0141 548 4273
Email: infoandadvice@strath.ac.uk
For more information visit the International Student Support webpage.

Strathclyde Students' Union's The Advice Hub
Phone: 0141 567 5040
Email: strathunion.advice@strath.ac.uk
For location see Strath Union's Advice Hub webpage.

Penalties for the Late Submission of Coursework

Coursework is deemed to be late when it is submitted after the published deadline without an agreed extension, and in the absence of personal circumstances.

The Policy and Procedure on Late Submission of Coursework provides a detailed account of the policy and procedures for the late submission of coursework. You should read this document carefully, noting that there may be exceptions to the policy outlined for specific types of coursework, such as (but not limited to) group work or presentations. Staff will communicate any such instances to students. However, in all instances, the range and timing of penalties will be applied according to a commitment to fairness and supporting all students in their studies alongside agreed procedures. Staff will monitor the late submission of assessments in order to identify any students who may require support. For regular coursework, the Policy and Procedure on Late Submission of Coursework outlines the penalties to be applied, and these are summarised below.

Penalties for Late Submission

Coursework that is submitted late, but within seven calendar days of the published deadline date and time, will be subject to penalties, as shown in the table below. The table demonstrates the application of a sliding scale of penalties, where a late submission within 24 hours of the deadline will incur a penalty of 10% applied to the original mark, and for each subsequent 24 hour period, an additional 5% penalty will be applied to the original mark. The table also shows that the application of penalties will be capped for coursework that is of a Pass standard. Coursework submitted after seven calendar days of the published deadline date and time will receive a mark of zero. Students who can demonstrate that they faced exceptional circumstances on the deadline day, and who submit their coursework within 4 hours of the published date and time, will not have their coursework subject to penalties. This 4 hour period is called the 'grace period' – see below the table for further information.

Example	Day of submission	Penalties applied
1.	Coursework submitted after the deadline, student has an approved extension and submits within the approved extension period.	No penalty to be applied.
2.	Late submission on the day of the deadline (or approved extended deadline), student has communicated exceptional circumstances and is granted a grace period of up until four hours after the deadline.	No penalty to be applied.
3.	Late submission within one calendar day (less than 24 hours) of the deadline, student has no approved extension.	10 percentage point penalty applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG).

4.	Late submission more than one calendar day (more than 24 hours) after the deadline but less than two full calendar days (less than 48 hours) after the deadline has expired, student has no approved extension.	15 percentage point penalty (10 points for first day, 5 points for second day or part day), unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG).
6.	Late submission more than two full calendar days (longer than 48 hours) after the deadline but less than three calendar days (72 hours), student has no approved extension.	20 percentage point penalty (10 for first day, 5 for second day, 5 for third day or part day), applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG)
7.	Late submission more than three full calendar days (longer than 72 hours) after the deadline but less than four full calendar days (less than 96 hours), student has no approved extension.	25 percentage point penalty (10 for first day, 5 for second day, 5 for third day, 5 for fourth day or part day), applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG)
8.	Late submission more than four full calendar days (more than 96 hours) after the deadline but less than five full calendar days (less than 120 hours), student has no approved extension.	30 percentage point penalty (10 for first day, 5 for second day, 5 for third day, 5 for fourth day, 5 for fifth day or part day), applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG)
9.	Late submission more than five full calendar days (more than 120 hours) after the deadline but less than six full calendar days (less than 144 hours), student has no approved extension.	35 percentage point penalty (10 for first day, 5 for second day, 5 for third day, 5 for fourth day, 5 for fifth day, and 5 for sixth day or part day), applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG).
10.	Late submission more than six full calendar days (more than 144 hours) after the deadline but less than seven full calendar days (less than 168 hours), student has no approved extension.	40 percentage point penalty (10 for first day, 5 for second day, 5 for third day, 5 for fourth day, 5 for fifth day, 5 for 6th day and 5 for the 7th part day), applied to original mark, unless the penalty reduces the student's mark to below 40% (UG) or 50% (PG), in which case the mark is capped at 40% (UG) and 50% (PG).

11.	Late submission more than seven full calendar days after the deadline. For example, a deadline was set for Midday on a Wednesday and a student submits an assessment after midday the following Wednesday	A mark of zero will be applied to the work.

Requesting the application of the grace period

If you experience unexpected circumstances before the time set on the day of the deadline and it results in a delay to your submission of less than four hours, you can request that the grace period is applied to your coursework submission via the late submissions tool in Myplace. If the reason provided is acceptable for use of the grace period, this will mean that a penalty is not applied to your mark. **Requests for the grace period to be applied must be submitted within 4 hours of the published date and time and no longer** – we strongly suggest that you submit your request as soon as you have submitted your coursework. To request that the grace period is applied:

1. Submit your coursework
2. In the assignment page containing information about the status of your submission and the deadline, click on the Late Submissions section to expand it
3. From the 'Reason for grace period' dropdown list, select the reason that best describes why you are requesting the grace period
4. Submit your request

The grace period will be automatically applied to your submission. However, if it becomes apparent that the grace period has been misused, a member of staff may revoke it and apply the appropriate late penalty. Instructions with images of the screen to support this explanation is also available.

Where a penalty is applied in Myplace, you can view the grade awarded to your work, the late penalty deducted and the final grade received after the deduction of the penalty. You can do this by expanding the *'late submissions'* section on the assignment page, once the grades have been released. Instructions with images of the screen to support this explanation is also available.

Penalty for late submission	The penalty applied as a percentage
Performant grade	The mark you would have received if there was no penalty
Pass mark	The mark required to pass the assignment
Marks deducted	The number of marks deducted (not the percentage deducted)
Effective percentage point penalty	How many percentage points were deducted
Grade	The mark returned to you shows you your Performant Grade minus the Marks Deducted

In the case of coursework to be submitted through Myplace, issues with Myplace which prevent students from submitting their coursework before the deadline will not result in late penalties. In this situation, staff will amend the deadline to allow enough time for students to successfully upload and submit their coursework after the issue has been resolved.

If you think you are unlikely to meet a coursework deadline due to medical issues or personal circumstances, please apply for an extension as early as possible.

Submission of the MSc Project
The MSc project thesis should be submitted to the Departmental Office and electronically via MyPlace. The submission date will be in early August.

The normal period of study is 12 months and the maximum period of study will only be allowed in exceptional circumstances. An extension of the MSc submission date will not normally be granted unless there are personal circumstances that can be evidenced.

Plagiarism and Collusion
Plagiarism is taking the work of others and presenting it as your own.
Collusion is using the work of a fellow student, with his or her knowledge, and presenting it as your own.
You could be accused of plagiarism if you:

- hand in (as your own) work that was written by someone else
- copy out someone else's work and hand it in
- copy out sections of someone else's work and include it in your own submitted work without acknowledging it
- use someone else's work in any of the above ways with a few words changed

That "someone else" might be the writer of a journal article, a textbook or an internet site. It could be a fellow student, though you might then be accused of collusion. The “work” could be a whole essay, paragraph or even sentence; i.e. copying (or altering in a minor way) a complete paragraph or sentence constitutes plagiarism.

You could be accused of collusion if:

- you and another student submit identical or almost identical work

Any work submitted for assessment, e.g. essays, laboratory reports, homework and tutorial assignments, must be solely the work of the individual student or group (if a group assignment is set). If there is evidence of plagiarism or collusion, penalties may be imposed ranging from a reduction in marks, to resubmission of work or, if particularly severe, to disciplinary action. Each case of plagiarism/collusion will be discussed by an adjudication panel who will recommend an appropriate course of action. The University’s guidance on plagiarism can be found using the url below. If you are in any doubt as to what constitutes plagiarism, please read this document. You will be proved with a copy of this document when you begin your course.

www.strath.ac.uk/media/ps/cs/gmap/academicaffairs/policies/student-guide-to-academic-practice-and-plagiarism.pdf

Absenteeism from Laboratory Sessions
Laboratory reports submitted by a student who was absent for the relevant session will normally result in a reduced mark. Consideration will be given if the student has a valid reason for being absent.

Absence & Mitigating Circumstances
For absences of seven days or less: Students who have been absent from the University for seven days or less should record a self-certification online via PEGASUS using the 'Personal Circumstances' link under the Services tab. You should also inform the Course Director.
For absences of more than seven days: Where sickness results in absence of more than seven days, the student is required to submit a medical certificate (signed by a medical practitioner who is not a member of the student's family) to Student Business. You should also inform the Course Director.
For absences from an examination: The self-certification convention does not apply and a student absent from an examination due to sickness **must submit a formal medical certificate**. All certificates that are submitted to Student Business are stored in the student's file. Student Business informs the relevant departments and Board of Examiners of certificates which are relevant to a diet of examinations or the corresponding period of study, including, where appropriate, the relevant details.

The University's policy on Mitigating Circumstances that have affected a student’s performance in assessments leading to the final mark for a class can be found on the following webpage:
https://www.strath.ac.uk/sees/studentpolicies/policies/appealscomplaintsdiscipline/personalcircumstancesprocedure/

Student feedback

Students have the opportunity to feedback their comments to staff. At the start of the academic year, we will ask for course representatives (normally 2) to be chosen from amongst the student cohort. These representatives will sit on the student-staff liaison committee (SSLC), which will sit three times a year, and comments on the course will be formally minuted and action taken where necessary. There will be other opportunities to provide feedback to module leaders at various points during the academic year. Please communicate any concerns you have at the earliest opportunity to the module leader, advisor of studies, or the course director.

LEARNING RESOURCES

MyPlace
The University's virtual learning environment (VLE) is called MyPlace. It is accessed using your DS credentials via the Strathclyde homepage, or directly from: classes.myplace.strath.ac.uk/

Many class resources will be available from MyPlace, however individual class tutors will inform you regarding the level of class engagement with the VLE.

Student Self-Development
The University provides a range of handouts that guide you through some common tasks at university. For example, reading and writing tips, grammar and language help, time management, avoiding plagiarism, making presentations and critical thinking.
These can be accessed here:
Academic support | University of Strathclyde

The University also provides online IT training for common software packages including Microsoft Office (Word, Excel, Powerpoint) and for University systems (Pegasus, Nemo, webdrives, MyPlace etc). The online tutorials can be accessed, using your DS username and password here:

Supporting Online Learning | University of Strathclyde

Staff will assume that all students are familiar with Microsoft Office to a basic level, and can engage with all University systems.

Printing and Photocopying
The University library offers a good printing and photocopying service.
Please contact: www.strath.ac.uk/is/studentprinting/ for information.

Library
We expect students to use the library independently as part of their daily study routine. Independent study using books and journal articles will augment class notes and facilitate a deeper understanding. A guide on how to use the library is here: Library | University of Strathclyde

COURSE REGULATIONS

You are encouraged to consult the Regulations governing your course on a regular basis. The Regulations set out the framework for your studies and specify the criteria for your progression through the course. The language is carefully chosen to cover all eventualities and may need some interpretation or clarification.

Please see link below for Regulations.

2023-24_Biomedical_Engineering.pdf (strath.ac.uk)

Academic Year 2023-24

University of Strathclyde Academic Calendar 2023-24

Date Week Commencing	University & Timetabling System Weeks	University Holidays	Academic Calendar
Mon 31/07/2023	1		Resit Exams
Mon 07/08/2023	2		Resit Exams end Tue 08/08/2023
Mon 14/08/2023	3		
Mon 21/08/2023	4		
Mon 28/08/2023	5		
Mon 04/09/2023	6		
Mon 11/09/2023	7		Welcome and Development Week
Mon 18/09/2023	8		Wk 1 Semester 1
Mon 25/09/2023	9	Mon 25.09.23	Wk 2
Mon 02/10/2023	10		Wk 3
Mon 09/10/2023	11		Wk 4
Mon 16/10/2023	12		Wk 5
Mon 23/10/2023	13		Wk 6
Mon 30/10/2023	14		Wk 7
Mon 06/11/2023	15		Wk 8
Mon 13/11/2023	16		Wk 9
Mon 20/11/2023	17		Wk 10
Mon 27/11/2023	18		Wk 11
Mon 04/12/2023	19		Semester 1 Exams
Mon 11/12/2023	20		
Mon 18/12/2023	21	TBC	Christmas Vacation
Mon 25/12/2023	22		Christmas Vacation
Mon 01/01/2024	23		Christmas Vacation
Mon 08/01/2024	24		Consolidation and Development Week
Mon 15/01/2024	25		Wk 1 Semester 2
Mon 22/01/2024	26		Wk 2
Mon 29/01/2024	27		Wk 3
Mon 05/02/2024	28		Wk 4
Mon 12/02/2024	29		Wk 5
Mon 19/02/2024	30		Wk 6
Mon 26/02/2024	31		Wk 7
Mon 04/03/2024	32		Wk 8
Mon 11/03/2024	33		Wk 9
Mon 18/03/2024	34		Wk 10
Mon 25/03/2024	35	Fri 29.03.24	Wk 11
Mon 01/04/2024	36	Mon 01.04.24	Spring Break
Mon 08/04/2024	37		Spring Break
Mon 15/04/2024	38		Semester 2 Exams
Mon 22/04/2024	39		
Mon 29/04/2024	40		
Mon 06/05/2024	41	Mon 06.05.24	
Mon 13/05/2024	42		
Mon 20/05/2024	43		
Mon 27/05/2024	44	Mon 27.05.24	
Mon 03/06/2024	45		
Mon 10/06/2024	46		
Mon 17/06/2024	47		
Mon 24/06/2024	48		
Mon 01/07/2024	49		
Mon 08/07/2024	50	Fri 12.07.24	
Mon 15/07/2024	51	Mon 15.07.24	
Mon 22/07/2024	52		Resit Exams Wed 24/07/2024-06/08/24

TIMETABLE FOR WELCOME AND DEVELOPMENT WEEK

There is a separate timetable for the first week of the first semester and it is important you attend. This week contains revision mathematics classes which are open to all, however those from a Life Science background are particularly encouraged to attend. These classes are not examined, but should provide you with the minimum mathematical content required for the MSc.

	Welcome and Development Week (Mon 11th - Fri 15th September 2023)				
	Monday 11/09/2023	Tuesday 12/09/2023	Wednesday 13/09/2023	Thursday 14/09/2023	Friday 15/09/2023
09:00					
10:00				Brief overview of online platforms	
11:00				Drop-in sessions for module choice	
12:00				Module Choice Interviews (Dept Office)	
13:00					
14:00			Department Research Profile Overview		Careers with June Cunningham
15:00					Bioeng soc & Student union (Molly, VP Sports) intro
16:00		Welcome Lecture			Social event
17:00					

SYNCHRONOUS ACTIVITIES	
Session Delivery Format	**Further details**
On-Campus	Teaching Room, Level 2, Wolfson Building

ASYNCHRONOUS ACTIVITIES
A series of Mathematics videos and resources will be available for you to work through in your own time during this week

Postgraduate Induction Week for Biomedical Engineering

The timetable for all the modules in the course is to be found at: www.strath.ac.uk/timetables/
Use this link to access the timetable for your modules.

When not in lectures the department expects students to be engaged in private study and preparation of course assignments.

Please note that Monday 25 September 2023 is a public holiday.

The following pages detail the individual classes (modules that may be taken as part of the MSc/PgDip Biomedical Engineering.

They are in numerical order, according to their class code (beginning BE…)

BE900	Tissue mechanics
BE901	Regenerative medicine
BE902	Prosthetics and orthotics
BE903	Cardiovascular devices
BE904	Clinical and sports biomechanics
BE905	Biosignal Processing and Analysis
BE906	Biomaterials and biocompatibility
BE907	Project
BE908	Biomedical instrumentation
BE909	Biomedical electronics
BE911	Engineering science
BE912	Anatomy and physiology
BE914	PgDip biomedical engineering dissertation
BE915	Medical science for engineering
BE916	Introduction to biomechanics
BE918	Professional studies in biomedical engineering
BE919	Research methodology
BE920	The medical devices regulatory process
BE923	Haemodynamics for Engineers
BE924	Medical Robotics
BE925	Numerical modelling in biomechanics
BE928	Rehabilitation Technology

MODULE DESCRIPTION FORM

BE900 Tissue Mechanics

Module Registrar: Dr Philip Riches	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved:	**Credit Weighting:** 10	**Semester:** 1
Compulsory/optional/elective class: None	**Academic Level:** 5	

Prerequisites:

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
12	12	12		12	52	100

Educational Aim

This module aims to provide an introduction to the mathematical theory of time-dependent mechanical properties of human tissue, i.e. viscoelasticity and poroelasticity. Finite Element modelling will be used to demonstrate tissue behaviour in a variety of loading scenarios. A group project of a specific tissue will enhance understanding of the application of the learned theory and demonstrate the state-of-the-art experimental techniques in the field.

Learning Outcomes

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

LO1 construct and discuss the relationship between the mechanical functioning and the microstructure of the main tissues of the body.
LO2 Understand two linear theories of time dependency in describing tissue behaviour and implement the two theories in a finite element analysis package to elucidate tissue behaviour.
LO3 Search, collate and digest current literature on the mechanical properties of tissue.
LO4 Critically appraise current experimental and modelling approaches to the above tissues.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Linear viscoelasticity theory as applied to biological tissue
Linear biphasic (poroelasticity) theory as applied to biological tissue
The implementation of these material behaviours in a finite element package
Group project of the mechanical behaviour of a specified tissue

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Describe the relationship between the mechanical functioning and the microstructure of the main tissues of the body.

C1 Describe the relationship between the mechanical functioning and the microstructure of compact and trabecular bone.

C2 Describe the relationship between the mechanical functioning and the microstructure of articular cartilage.

C3 Describe the relationship between the mechanical functioning and the microstructure of ligaments.

LO2 Understand two linear theories of time dependency in describing tissue behaviour and implement the two theories in a finite element analysis package to elucidate tissue behaviour

C1 devise and solve simple linear viscoelastic analogue models

C2 understand the derivation of poroelasticity and analyse its equilibrium behaviour

C3 Be able to implement the material models in computer models and interpret their time dependent behaviour.

LO3 Search, collate and digest current literature on the mechanical properties of tissue.

C1 Be able to identify pertinent research literature regarding a specific question in this field.

C2 Understand and contextualise the literature within the development of understanding in this area.

LO4 Critically appraise current experimental and modelling approaches to the above tissues.

C1 Demonstrate a critical knowledge in a single tissue.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:-

One exam, one piece of coursework (computer laboratory write up) and one presentation (research synthesis and critique) will be used for assessment purposes. The weighting of each assessment will be between 20% and 60% and chosen by each student, adding up to 100%. Thus the assessment will be completely individualised and shaped by each student.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	1 hour	20-60	2	20-60		
LO1, LO2, LO4			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Lab report week 9. Presentation week 11 (semester 2)

Resit Examination Procedures:

Exam Only

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam and coursework.

Recommended Reading:

Nigg B., Herzog W. Eds. (1999) Biomechanics of the musculoskeletal system. John Wiley & Sons
Cowin SC, Doty SB (2007) Tissue Mechanics, Springer

Some up to date research articles will be provided for class discussions and students will be expected to find many more.

Additional Student Feedback:

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

Wednesday, Weeks 6 and 11 Semester 2.

MODULE DESCRIPTION FORM

BE901 Regenerative Medicine and Tissue Engineering

Module Registrar: Dr Peter Childs	**Taught To:** MSc/PgDip/PGCert Biomedical Engineering	
Other Lecturers Involved: Dr Christopher McCormick Guest lecturers	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	
Prerequisites: BE915 Medical Science or a Life Sciences Degree		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
24	2		24		50	100

Educational Aim

To describe the development and advances in regenerative medicine/repair medicine in terms of:

- Source of cells
- Cell expansion/seeding and bioreactor technology
- Tissue scaffolds: design criteria, fabrication and characterisation
- Clinical status of replacement tissues and organs

Learning Outcomes

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

LO1 Appreciate the difficulties in sourcing a suitable supply of cells to produce artificial organs and tissues.

LO2 Understand the importance of mass transfer and membrane transport in relation to cell expansion and the design of bioreactors in general.

LO3 Know the characteristics required of materials used for scaffolds in tissue engineering, and how their physical properties can be measured.

LO4 Have discovered the most recent advances in regeneration and repair of cartilage; skin; pancreas; liver; neural tissue and retina.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

- Sources of cells for tissue replacement and repair – primary and immortalised cells and stem cells.
- Differentiation of stem cells into functional tissue cells in vitro and in vivo.
- Bioreactor technology and design, including principles of mass transfer, oxygenation and the supply of nutrients and removal of waste products; membrane transport.
- Scaffolds for 2-D and 3-D tissue engineering- effects of surface chemistry and physical properties on adhesion; porosity and its effect on cell distribution and vascularisation.
- Mechanical characterisation of engineered tissues.
- Advances in the replacement of organs and tissues including– cartilage; skin; pancreas; liver; neural tissues and retina.

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Appreciate the difficulties in sourcing a suitable supply of cells to produce artificial organs and tissues.
C1 Know the different options for supply of cells and their advantages and limitations.
C2 Understand the sources for stem cells and their advantages and limitations.

LO2 Understand the importance of mass transfer, oxygen and nutrition supply, and membrane transport in the design of bioreactors.
C1 Understand the process of mass transfer and how it is affected by diffusion and convection.
C2 Be aware of how oxygen and nutrients are supplied to bioreactor environments.
C3 Understand basic membrane transport processes.

LO3 Know the characteristics required of materials used as scaffolds in tissue engineering, and how their physical properties can be measured.
C1 Appreciate how cell adhesion to materials can be influenced by chemical and physical properties of materials, and the conditions under which cells/materials are cultured *in vitro.*
C2 Know how the mechanical properties of engineered tissues can be measured, and manipulated.
C3 Understand the importance of porosity and interconnectivity in scaffolds.

LO4 Have discovered the most recent advances in replacement/repair of cartilage; skin; pancreas; liver; neural tissue and retina.
C1 Know the anatomy, physiology and function of the tissues which are being repaired.
C2 Learn about the source of cells to be used and the options for scaffolds available for each tissue/organ.
C3 Appreciate the stage of development of the engineered tissues aiming towards clinical therapy.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

The lecturers will interact, and actively discuss and debate topics, with the students. High quality feedback will be provided to encourage students to correct their work and develop their ideas. Students will be encouraged to take the time and put in the effort to learn about the field. Student feedback will be sought to improve content and style of the course.

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

Examination			Group Project			
Number	Duration	Weighting	Number	Weighting		
1	2 hours	60	1	40		
LO1-LO4			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Group Project Presentation task will be set in week 4, with presentations delivered during week 6.

Resit Examination Procedures:

Failed coursework shall be submitted prior to a resit at the next available exam diet. Failed examinations will be attempted again at the August resit diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

Journal papers will be used to illustrate the most recent advances in regeneration and repair of tissues in animals and humans. The most recent literature review articles will be used to provide state-of –the- art information on the topics.

Additional Student Feedback:

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

Feedback on summative assignments will be provided within three weeks of submission. Feedback will also be provided through supported tutorial activities. Peer to peer feedback will be encouraged.

MODULE DESCRIPTION FORM

BE902 Prosthetics and Orthotics

Module Registrar: Dr Arjan Buis	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Various members of NCPO staff	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	

Prerequisites: BE916 Introduction to Biomechanics or equivalent as deemed suitable by the course director.

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
30	3			12	55	100

Educational Aim

This module aims to demonstrate to students how biomechanical principles can be applied to the design, manufacture, fitting procedures and evaluation of prostheses, orthoses and other devices externally applied to the body of patients in need of rehabilitation. It is hoped that students taking this module should be able to join manufacturing companies, research groups or clinical teams responsible for the delivery of such systems.

Learning Outcomes

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

LO1 Demonstrate knowledge and understanding of the biomechanical principles as applied to the design of prosthetic/orthotic (P&0) devices and other rehabilitation aids.

LO2 Demonstrate knowledge and understanding of device selection criteria to suit various pathologies presented, manufacturing and fitting processes, and clinical practice.

LO3 Demonstrate knowledge and understanding of the experimental and analytical procedures used to determine relevant kinematic and kinetic parameters which allow the function, strength and safety in use of the devices to be evaluated.

LO4 Discuss design aspects and improvements of prosthetic and orthotic devices.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Lower limb prosthetics: Study of conventional and modern types of prostheses. This will cover prosthetic sockets, feet, ankle/ knee/ hip joints, alignment devices, cosmetic restoration and suspension systems. Biomechanical analyses related to function, comfort and strength aspects will be discussed. Socket design, alignment, fitting procedures and techniques, gait analysis. Analysis of swing and stance mechanisms.

Lower limb and spinal orthotics: Indications, principles, biomechanics and construction, patient matching, load analysis will be discussed.

Upper limb prosthetics: Body and externally powered.

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Demonstrate knowledge and understanding of the biomechanical principles as applied to the design of prosthetic/orthotic (P&0) devices and other rehabilitation aids.
C1 Describe the mathematical principles of static and dynamic mechanical analysis as appropriate to P&O.
C2 Use mechanical and biomechanical principles to solve problems in P&O.

LO2 Demonstrate knowledge and understanding of device selection criteria to suit various pathologies presented, manufacturing and fitting processes, and clinical practice.
C1 Describe pathologies requiring P&O intervention.
C2 Describe the types of P&O required to address the clinical treatment of each pathology.
C3 Describe the manufacturing and fitting process of each P&O.

LO3 Demonstrate knowledge and understanding of the experimental and analytical procedures used to determine relevant kinematic and kinetic parameters which allow the function, strength and safety in use of the devices to be evaluated.
C1 Describe mechanical testing of P&Os.
C2 Describe modelling of P&Os.
C3 Describe how the obtained P&O parameters assess the function of the P&O.

LO4 Discuss design aspects and improvements of prosthetic and orthotic devices.
C1 Synthesise the above knowledge to demonstrate a holistic understanding of P&O.
C2 Utilise overall understanding to knowledgeably discuss P&O designs.
C3 Utilise overall understanding to knowledgeably suggest P&O design improvement.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

Assessment is carried out by means of an examination paper and 2 assignments which are to be handed in. See below for details. Tutorials will be provided to work through problems where teacher feedback is available when students get stuck This ensures the feedback is timely. In the lectures and tutorials, the teacher will model in class how they would think through and solve 'exemplar' problems paying specific attention to the concepts behind the problems and the different solution strategies including incorrect pathways Feedback will be obtained through a structured questionnaire form and voluntary group discussion at the conclusion of the course.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	70%	2	30%		
LO1-LO3			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Assignment	Handed-out	Handed-in
1	Week 2	Week 5
2	Week 6	Week 9

Resit Examination Procedures:

A resit examination paper will be set for the August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

There are no recommended text books for this class. Handouts will be given throughout the course and students will be directed to appropriate supplementary reading material. Appropriate material will also be provided in Myplace.

Additional Student Feedback:

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

Feedback will be given on assignments as follows:-

Assignment 1 During weeks 7-9
Assignment 2 Week 11

MODULE DESCRIPTION FORM

BE903 Cardiovascular Devices

Module Registrar: Dr Craig Robertson	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Professor Terence Gourlay, Mr Mark Danton (Royal Hospital for Sick Children), Mr Nawwar Al Attar, Mrs Ida Torrance and Prof Keith Oldroyd (Golden Jubilee), Prof Will Shu, Dr Asimina Kazakidi, Dr Monica Rozeik, Dr Chris McCormick and Dr Wei Yao	**Credit Weighting:** 10	**Semester:** 1
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	
Prerequisites:		

Module Format and Delivery (hours):

Lectures	Tutorial	Laboratory	Project	Assignment	Private Study	Total
30				40	30	100

Educational Aim

This module aims to:

- Give students a broad overview of cardiovascular devices used in the clinical setting for the treatment of a range of clinical conditions.
- Demonstrate and develop an understanding of the clinical, design and regulatory challenges involved in developing devices for this clinical sector.
- Offer some insight into the pathologies underlying the need for cardiovascular device technologies.

Learning Outcomes

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

LO1 Understand the important elements of cardiopulmonary bypass and support systems.
LO2 Recognise the challenges, in terms of biocompatibility, associated with implantable and extracorporeal cardiovascular devices.
LO3 Understand the different and emerging valve replacement options available to clinicians
LO4 Understand the different technologies for heart failure, including minimally invasive interventions, the repair of congenital heart lesions and the role of the cardiac ITU.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

- The history and principals of Cardiopulmonary Bypass (CPB)
- The design, development and clinical applications of Extracorporeal Membrane Oxygenation (ECMO).
- The history and design of conventional artificial heart valves and transcatheter aortic valve implantation (TAVI).
- The challenges and advantages of the percutaneous approach to heart valve replacement.
- The history, current status and clinical challenges associated with the use of ventricular assist devices (VADs)
- Robotic heart surgery
- Vascular regenerative techniques
- Mathematical modelling of the cardiovascular system
- History, current status and future of cardiovascular stents.
- Aspects of safety related to the clinical use of cardiovascular devices.
- An individual assignment based on a cardiovascular device clinical application.

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Understand the important elements of cardiopulmonary bypass and support systems
C1 Describe the main components of a CPB system and the equations used to calculate heat and oxygen transfer in a counter-current device.
C2 Explain the difference between CPB and ECMO with reference to the technologies employed.
C3 Describe the devices and techniques employed to ensure safe use of CPB and ECMO technologies.

LO2 Recognise the challenges, in terms of biocompatibility, associated with implantable and extracorporeal cardiovascular devices.

C1 Explain the in terms of blood/tissue/biomaterial contact, the inflammatory response to cardiovascular devices.
C2 Describe the techniques employed to enhance biocompatibility of cardiovascular devices.
C3 Explain the major clinical effects of bio-incompatibility in patients undergoing ECMO procedures.

LO3 Understand the different valve replacement options available to clinicians.
C1 Describe the different types of conventional artificial heart valves.
C2 Describe the different types of percutaneous artificial heart valves including TAVI.
C3 Describe the limitations, advantages and drivers associated with the development and deployment of percutaneous heart valves.

LO4 Understand the different technologies for heart failure, including minimally invasive interventions, the repair of congenital heart lesions and the role of the cardiac ITU
C1 Describe the different types of technologies for heart failure, with an understanding of specific minimally invasive interventions
C2 Explain the different techniques used for the repair of congenital heart lesions and their clinical outcomes.
C3 For a given clinical condition, select the appropriate surgical intervention and mode of use.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

Student feedback will be obtained through interaction during tutorial sessions associated with the project work. Examination will be by closed book examination, but further assessment will be undertaken through assessment of assignments and individual project reports.

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

Examination			Coursework	
Number	Duration	Weighting	Number	Weighting
1	2 hours	70%	1	30%
LO1-LO4			LO1-LO3	

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

One coursework assignment will be set in week 4 with submission in week 10.

Resit Examination Procedures:

Examination only**.**

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. For details of this re-examination see above.

Recommended Reading:

Materials and Devices of the Cardiovascular System.(Gourlay and Black eds). Woodhead Publishing Ltd, Cambridge, UK
Minimized Cardiopulmonary Bypass: Technologies and Applications (Gourlay and Gunaydin eds). Woodhead Publishing Ltd, Cambridge, UK

Additional Student Feedback:

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

Weeks 6 and 11

MODULE DESCRIPTION FORM

BE904 Clinical and Sports Biomechanics

Module Registrar: Dr. Andy Kerr	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Professor Phil Rowe, Dr Craig Childs and visiting lecturers	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	
Prerequisites: BE916 Introduction to Biomechanics		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
14	7	12	7	20	40	100

Educational Aim

This module aims to provide the student with the ability to appraise the role of biomechanics and biomechanical measurement techniques in the physical rehabilitation of movement disorders and sports performance.

Learning Outcomes

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

LO1 Employ biomechanical principles to assess qualitatively clinical and sports related performance.

LO2 To appraise different biomechanical measurement technologies and to compare their strengths and weaknesses in different measurement settings.

LO3 To evaluate the role of biomechanics in the rehabilitation of movement disorders and sports injuries.

LO4 Evaluate the role of biomechanics in understanding clinical and sports practice and judge its likely impact on the design of medical, rehabilitation, and sports technology and on the design, implementation and evaluation of rehabilitation technology services.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Motor control

Principles of rehabilitation

Neurological control of movement

Nine things to measure in relation to movement

Measurement equipment deployed in biomechanics

Measurement properties

Measuring movement outside the lab

3D motion capture

3D biomechanics and surgery in cerebral palsy

Robotic rehabilitation

Sports performance and enhancement

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Employ biomechanical principles to assess qualitatively clinical and sports related performance.

C1 Comprehend and apply the concepts of forces, moments, displacement, velocity & acceleration in both linear and angular contexts

C2 Create suitable qualitative analyses of clinical and sports related tasks.

C3 Construct suitable analytical solutions for these problems using words and pictures.

LO2 To appraise different biomechanical measurement technologies and to compare their strengths and weaknesses in different measurement settings.

C1 To comprehend the different types and complexities of biomechanical measurement technologies and what their record.

C2 To deploy suitable biomechanical measurement techniques in an efficient manner to relevant movement issues using judgement as to the best tool for the job.

C3 To evaluate the results of these measurement techniques and interpret their implications for human movement and health.

LO3 To evaluate the role of biomechanics in the rehabilitation of movement disorders and sports injuries.
C1 To comprehend the biomechanical consequences of loading on the musculo-skeletal system.
C2 To appraise the potential for biomechanics to enhance rehabilitation.
C3 To comment knowledgeably on the potential for technology to enhance rehabilitation
LO4 Evaluate the role of biomechanics in understanding clinical and sports practice and judge its likely impact on the design of medical, rehabilitation, and sports technology and on the design, implementation and evaluation of rehabilitation technology services.
C1 To appraise the role biomechanics has played in the understanding of clinical practice and sport performance.
C2 To appraise the role biomechanics has played in advancing clinical practice and sports.
C3 To estimate its likely future impact on clinical practice and sports.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

An e-learning myplace website will be used to facilitate learning, assessment and feedback. The website will include all teaching material, powerpoint copies of lectures, examples and solutions, a previous exam paper with answers and suggested links to other learning resources. The website will also include pre module revision information and suggestions for further reading. Assignments will be directly relevant to current material and a feedback sheet giving the marks will be used to return performance to students. Interaction between staff and students and dialogue relating to delivered material will be encouraged in lectures and laboratories and an online chat facility will be included in the web package. Clear instructions will be given to students regarding the assignments in both written and verbal format.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			1	50	1	50
			LO1-LO4		LO1-LO4	

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

The class will be taught over 11 weeks of semester 2
Assignment (group activity) presented during week 6
Assignment 2 submitted during exam period

Resit Examination Procedures:

Coursework resubmission prior to August exam Diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Recommended Reading:

An Introduction to Human Movement and Biomechanics, 7th Edition, Andrew Kerr and Philip Rowe (2019) ISBN 9780702062360
Functional human movement: measurement and analysis
Brian R Durward; Gillian D Baer; Philip J Rowe
Oxford; Boston, Mass: Butterworth-Heinemann 1999
Biomechanics and motor control of human movement
David A. Winter 1930-
3rd ed. New Jersey : John Wiley & Sons 2004

Additional Student Feedback:

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

There will be an opportunity for students to gain feedback halfway through the module by presenting and receiving formative feedback on a group presentation

Session: Feedback on the final assessment will also be given electronically through the module myplace e-learning package following the relevant exam board.

MODULE DESCRIPTION FORM

BE905 Biosignal Processing and Analysis

Module Registrar: Dr David Li				**Taught To:** MSc/MRes Biomedical Engineering		
Other Lecturers Involved:				**Credit Weighting:** 10		**Semester:** 2
Compulsory/optional/elective class: Optional				**Academic Level:** SHE5		
Prerequisites: Mathematics and Physics (Higher)						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
30 hours		Noncompulsory			60 hours	90 hours

Educational Aim

This module aims to familiarise students with the fundamentals and concepts of signals and systems (both continuous-time and discrete-time), and to develop a framework for processing and analysing a variety of biomedical signals and images, including electromyography, electrocardiograms (ECGs) and magnetic resonance images. Students will also develop valuable signal/image processing skills, through non-compulsory self-study laboratory exercises.

Learning Outcomes

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

LO1 Understand the origin and nature of biosignals.

LO2 Have the necessary theoretical background to comprehend many important biosignal processing concepts.

LO3 Relate to important advanced biosignal processing techniques

LO4 Have the necessary practical experience to implement a large variety of algorithms and techniques (non-compulsory self-study laboratory exercises).

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

1. Signals and Systems: Background, Fourier Analysis, Laplace Transform, Data Conversion, *Z*-Transform, Examples.
2. Digital Filters: Introduction, Finite impulse response (FIR) and infinite impulse response (IIR) filters, Realisations, Frequency response, Generic design procedure, Frequency domain representations, Discrete Fourier series and discrete-time Fourier transform (DTFT), FIR digital filter design, Linear phase, Window design method, Examples.
3. Discrete Fourier Transform (DFT): Motivation, Derivation, Properties, Fast Fourier transform (FFT), Decimation-in-time algorithm, Bit reversal, Decimation-in-frequency algorithm, Examples.
4. Image Processing: Basics of medical imaging including MRI, CT, SPECT, PET and ultrasound, Image transforms, Image enhancement, Low-pass and high-pass 2-D filters, Histogram equalisation, Image segmentation, Examples.
5. Introduction to Advanced Techniques: Adaptive filtering, Artificial Neural Networks (ANNs), Timefrequency analysis, Non-linear processing, Telemedicine, Data compression, Biosignal applications.
6. Biosignal Processing: Electrocardiograms (ECGs), Seismocardiograms, Electroencephalograms (EEGs), Event-related potentials (ERPs), Sleep apnea, Diabetes, Medical ultrasound, Radiotherapy treatment planning.

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into ‘teachable’ elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Understand the origin and nature of biosignals.
C1 Describe the physiological basis for the main biosignals.
C2 qualitatively describe the expected “normal” biosignal.
C3 qualitatively describe the effect of health status on the biosignal.

LO2 Have the necessary theoretical background to comprehend many important biosignal processing concepts.

C1 Be able to name and describe the purpose of various biosignal processing techniques. C2 Know when it is appropriate to apply each technique.

LO3 Relate to important advanced biosignal processing techniques.
C1 Describe qualitatively some advanced examples of biosignal processing.

C2 Qualitatively discuss the importance and role of advanced biosignal processing in their field.

LO4 Have the necessary practical experience to implement a large variety of algorithms and techniques.
C1 Describe the effect on the biosignal, using pre-written numerical routines.

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

Principles of Assessment and Feedback

The University’s Assessment and Feedback Policy can be found at:www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

Students will be assessed midway through the module. This assessment will constitute 30% of the total mark Students will get timely formative and summative feedback on their performance.

Students will be given opportunity at the end of the module for further feedback.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
2	1 hr & 2 hrs	30% & 70%				
LO1-LO4						

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines: N/A.

Resit Examination Procedures: Exam

diet in August.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

1. Ambardar, A., 1999, Analog and Digital Signal Processing (2nd Ed.), *Brooks/Cole*.
2. Denbigh, P.N., 1998, System Analysis and Signal Processing, *Addison-Wesley*.
3. Ifeachor, E.C. & B.W. Jervis, Digital Signal Processing: A Practical Approach (2nd Ed.), *Pearson Prentice Hall*.
4. Ludeman, L.C., 1987, Fundamentals of Digital Signal Processing, *Wiley*.
5. Lynn, P.A. & W. Fuerst, 1994, Introductory Digital Signal Processing with Computer Applications (2nd Ed), *Wiley*.
6. McClellan, J.H., R.W. Schafer & M.A. Yoder, 2003, Signal Processing First, *Pearson Prentice Hall*.

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE906 Biomaterials and Biocompatibility

Module Registrar: Dr Christopher McCormick	**Taught To:** MSc/MRes/PgDip/PgCert Biomedical Engineering	
Other Lecturers Involved: Prof MH Grant, Dr Milovan Cardona (BME), Drs A McLaren and A Toumpis (Mechanical & Aerospace Engineering)	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	
Prerequisites: None		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
31	9			12	48	100

Educational Aim

This module aims to:

- Provide fundamental information on the properties of synthetic biomaterials, and how these are evaluated experimentally and from the literature
- Outline how material properties are influenced by methods of processing
- Explore with the aid of appropriate examples what is meant by biocompatibility; provide an overview of the host responses to and interactions with biomaterials, and how these interactions are assessed and influenced by surface properties
- Introduce the principles of toxicology, identify the major toxic interactions with foreign chemicals and the protective mechanisms which enable us to survive most toxic insults. Assessment of the safety of materials according to the International Standards will be discussed.

Learning Outcomes

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

LO1 Understand the relationship between structure of metals & ceramics and their behaviour as a basis for materials selection in biomedical applications.

LO2 Have a good understanding of the concept of biocompatibility as it relates to materials for implantation into different systems of the body; and of the interactions of tissues and body fluids with materials.

LO3 Be able to identify appropriate methods to assess biocompatibility, and to understand the relevance and limitations of those assessment procedures to clinical outcomes.

LO4 Understand how to assess and quantify toxic responses to foreign chemicals.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The approach to metal, ceramic, composite and polymer engineering will be to integrate the description of materials in terms of their basic behaviour (brittle, ductile, plastic, elastic, viscoelastic) applied to Biomedical Engineering applications. The basic understanding will be established through examples with back-up software which will cover materials science in an interactive programme.

Manufacture of artefacts will be described in terms of basic materials behaviour governing the methods of fabrication and the consequences for use of those processing routes. Links between the properties of the materials considered, their selection, and processing will be made with reference to examples and demonstrations taken from Biomedical Engineering applications.

The concept of biocompatibility will be introduced with reference to the historical uses of materials in medicine, and the many successes and failures in clinical practice. The view that biocompatibility is akin to inertness will be challenged by citing examples of materials that illicit specific responses that are appropriate for their intended application, and the specific requirements of materials for use in cardiovascular applications, Tissue Engineering and Regenerative Medicine.

Toxicology: Quantification of toxic responses; in vitro and in vivo testing for toxicity; safety evaluation of materials according to the International Standards; mechanisms of toxicity and protective mechanisms of the body; inflammation; carcinogenesis; effect of the tissues and body fluids on materials.

Assessment of Learning Outcomes

Criteria

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

LO1 Understand the relationship between structure of metals & ceramics and their behaviour as a basis for materials selection in biomedical applications.
- C1 Identify the types of bonding present in metals and ceramics, and explain how material structure and processing influences those properties;
- C2 Ability to perform basic calculations of material strength, elastic modulus, etc., for each class of material.

LO2 Good understanding of the concept of biocompatibility as it relates to materials for implantation into different systems of the body; and of the interactions of tissues and body fluids with materials.
- C1 Ability to explain the nature of the interactions between tissues and body fluids (e.g. blood) on materials, both acute and chronic; and
- C2 The manner in which surfaces properties in particular influence protein-cell-biomaterial interactions at the tissue interface.

LO3 Identify appropriate methods to assess biocompatibility, and to understand the relevance and limitations of those assessment procedures to clinical outcomes.
- C1 Describe methods used to assess blood-biomaterial biocompatibility: in vitro, ex vivo, in vivo; and
- C2 Explain the relevance and limitations of these assessment procedures in predicting device performance.

LO4 Understand how to assess and quantify toxic responses to foreign chemicals.
- C1 Describe mechanisms of toxicity and protective mechanisms of the body.
- C2 Detail *in vitro* and *in vivo* testing for toxicity.
- C3 Cite the relevant International Standards that apply.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

The module comprises a combination of summative and formative assessments, making full use of the University's Virtual Learning Environment 'Myplace'; the software will be used also to promote interaction between individual students and their tutors, and to tailor feedback on performance to individual students. Likewise, student feedback will be sought to improve both content and delivery of the course.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2	70%	1	30%		
LO1-LO4			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Coursework set in week 5 and submitted in week 11 (semester 2). The assignment will make use of the materials selection software package CES Edupack, available to students of the University on site licence.

Resit Examination Procedures:

Examination.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

Callister WD, Materials Science & Engineering (Wiley: New York)

Young RJ and Lovell PA, Introduction to Polymers (CRC Press, Boca Raton, FL, USA)

McCrum NG, Buckley CP, Bucknall CB, Principles of Polymer Engineering (Oxford University Press)

Park JB and Lakes RS, Biomaterials - An Introduction (Plenum Press, New York)

Pruitt LA and Chakravartula AM, Mechanics of Biomaterials: fundamental principles for implant design (Cambridge University Press), 2011 (electronic access)

Ratner (ed), Biomaterials Sciences: an introduction to materials in medicine (Elsevier Academic Press) 3rd edition (electronic access)

Dee KC, Puleo DA, Bizios R 'An introduction to tissue-biomaterial interactions' (John Wiley & Sons)

JA Timbrell 'Introduction to Toxicology' (Taylor & Francis)

Additional Student Feedback:

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

Via MyPlace

MODULE DESCRIPTION FORM

BE907 Project

Module Registrar: Dr Christopher McCormick				**Taught To:** MSc Biomedical Engineering		
Other Lecturers Involved: All BME Academic & Research Staff				**Credit Weighting:** 60		**Semester:** 3
Compulsory/optional/elective class: Compulsory				**Academic Level:** SHE 5		
Prerequisites: None						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
			600			600

Educational Aim

This module aims to provide an opportunity for students to experience the challenges and rewards of sustained, independent study in a topic of their own choice in the general field of Biomedical Engineering. It will involve students in a number of processes which include justification of the selected topic; selecting, devising and applying appropriate methods and techniques; anticipating and solving problems which arise; displaying knowledge of background literature; and evaluating and reporting the conclusions of the study. The project may take the form of an extended literature review or involve experimental work. This project work will have been supported by a compulsory research methods module and specialist knowledge classes throughout the year designed to assist with technical aspects of methodology and analysis.

Learning Outcomes

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

LO1 Demonstrate a critical understanding of the principal theories, principles and concepts of their chosen topic field.

LO2 Show autonomy in planning and executing a significant project of research, investigation or development.

LO3 Apply critical analysis, evaluation and interpretation to their own experimental data and/or that of other published work.

LO4 Effectively communicate and discuss their research with non-specialists, peers, technically adept non-specialists and specialists in their chosen field.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

There is no formal syllabus to this module. Supervisors will guide students through an appropriate research process.

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 **Demonstrate a critical understanding of the principal theories, principles and concepts of their chosen topic field**.
C1 Describe the appropriate theoretical background for their project, including any underlying assumptions.
C2 Describe alternative theories/methodologies where appropriate and discuss the differences between approaches.
C3 Provide a fully-informed justifiable rationale for their research.

LO2 **Show autonomy in planning and executing a significant project of research, investigation or development**
C1 Develop an appropriate methodology to examine the research question
C2 Execute the developed methodology
C3 Critically appraise the execution of the methodology

LO3 **Apply critical analysis, evaluation and interpretation to their own experimental data and/or that of other published work.**
C1 Handle, present and discuss numerical data in an accurate and appropriate manner.
C2 Discuss their analysis in the light of the theoretical framework.

LO4 **Effectively communicate and discuss their research with non-specialists, peers, technically adept non-specialists and specialists in their chosen field**.
C1 Use a good standard of written and verbal technical English.
C2 Explain complex technological and scientific concepts with clarity of expression.
C3 Discuss and justify the written thesis.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

Regular student-supervisor meetings will deliver regular high quality feedback on progress providing ample opportunity for students to understand and to attain the expected level of achievement. Students will be working within a project area of their choice maintaining motivation and interest in their work. Whilst independent, a healthy research buzz within the Bioengineering Unit provides a motivational learning community with peer-peer encouragement and support in addition to that from the supervisor.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1		30%			1	70%
LO1-LO4					LO1-LO4	

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Thesis submission deadline is mid-August. An oral examination will take place in early September. The viva will start with a short Poster presentation of the main research findings by the student to the examiners.

Resit Examination Procedures:

Students who fail to provide a satisfactory project at the first attempt will be asked to do corrections and to resubmit within an agreed timescale.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module.

Recommended Reading:

Individual supervisors will recommend initial reading. It is then up to the student to direct themselves in collating the appropriate literature.

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE908 Biomedical Instrumentation

Module Registrar: Dr David Li	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: some lectures will be delivered as invited seminars	**Credit Weighting:** 10	**Semester:** 1
Compulsory/optional/elective class: Compulsory	**Academic Level:** SHE 5	
Prerequisites: BE915 Medical Science or BE911 Engineering Science		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
10	23			16	51	100

Educational Aim

This module aims to:

Give a detailed description of the principles and applications of a number of the most widely used biomedical instrumentation systems and devices found in the modern hospital environment. This course, partly delivered through lectures, and partly via a flipped classroom approach, where the theory is presented in media material complemented by tutorials and demonstrations in the classroom, will enable students to understand the diagnostic and research applications of the various instrumentation-related techniques currently available and to appreciate their limitations.

Learning Outcomes

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

LO1 Describe the function and makeup of basic transducer and biosensor systems.

LO2 Understand the principles underlying basic physiological monitoring techniques and technologies.

LO3 Demonstrate knowledge of imaging technologies from a theoretical and practical standpoint: ultrasound imaging, scanning and nuclear imaging including CT, MRI and PET.

LO4 Understand the recent evolutions in digital and mobile health.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

- Basic transducers, electrodes, biosensors and their applications
- CT scanning and nuclear imaging
- Medical ultrasound and blood flow measurement
- Modern radiotherapy and associated instrumentation
- Cardiology instrumentation
- Digital and mobile health applications

Assessment of Learning Outcomes

Criteria
For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:
[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Describe the function and makeup of basic transducer and biosensor systems.
C1 Understand the principles of the signal sensing chain.
C2 Describe resistance, capacitance, inductive and piezoelectric transducers.
C3 Understand the electrode theory, the Nernst equation and the Ag-AgCl electrode.

LO2 Understand the principles underlying basic physiological monitoring techniques and technologies.
C1 Understand the principles of biosignals and noise.
C2 Describe the basic function of the ECG machine.
C3 Understand the source and diagnostic importance of different ECG leads.

LO3 Demonstrate knowledge of imaging technologies from a theoretical and practical standpoint: ultrasound imaging, scanning and nuclear imaging including CT, MRI and PET.
C1 Understand the use of radio-isotopes in cancer care, including safety issues involved in radiotherapy.
C2 Describe the importance of the "care plan" in patients undergoing radiotherapy.

C3 Describe the properties and technologies of ultrasound as a diagnostic and blood flow measurement tool.

LO4 Understand the recent evolutions in digital and mobile health.
C1 Describe the remit and scope of digital and mobile healthcare technology.
C2 Describe recent advances in digital and mobile healthcare.
C3 Understand limitations and barriers to introduction of digital and mobile healthcare technologies.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/
Specific details relating to this class are as follows:

Student feedback will be obtained through interactions associated with the numerous tutorials. Examination will be by closed book examination, but further assessment will be undertaken through assessment of coursework.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1		70%	1	30%		
LO1-LO4			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Coursework submission will be midway in the module.

Resit Examination Procedures:

One 2 hour examination at the August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. For details of this re-examination see above.

Recommended Reading:

None – reading material will be supplied as part of the module.

Additional Student Feedback:

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

A feedback session will be organised between registrar and students at the end of the course.

MODULE DESCRIPTION FORM

BE909 Biomedical Electronics

Module Registrar: Dr Mario Ettore Giardini				**Taught To:** MSc/MRes Biomedical Engineering		
Other Lecturers Involved: none				**Credit Weighting:** 10		**Semester:** 1
Compulsory/optional/elective class: Compulsory				**Academic Level:** 5		
Prerequisites: BE911 Engineering Science or equivalent						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
22	6	5		26	41	100

Educational Aim

This module aims to give the student a thorough introduction to the use of electronic circuits for the pre-conditioning, acquisition and display of biomedical signals and to provide an understanding of the components required in a basic biomedical measurement device.

Learning Outcomes

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

LO1 Understand the basis of biomedical signals that might be monitored by an electronic device or system.

LO2 Recognise the basic mathematical models for such systems.

LO3 Understand the important electronic components in a modern biomedical measurement system.

LO4 Be able to specify a basic biomedical measurement system.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Specification of biomedical sensors and instrumentation. Sensor/transducer characteristics and mathematical models. Effects of the conditioning circuit on biomedical measurement. Noise and errors.
Introduction to operational amplifiers. Theory of positive and negative feedback around amplifiers.
Signal preconditioning. Instrumentation amplifier. Differential voltage amplification with frequency limits.
A/D conversion. Specifications, sampling, aliasing,
Use of microcontrollers in Biomedical Engineering.
Individual project specifying a biomedical device for signal monitoring.

Assessment of Learning Outcomes

Criteria
For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:
[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Understand the basis of biomedical signals that might be monitored by an electronic device or system
C1 Describe the physiological processes that generate biomedical signals and the mathematical or electrical characteristics of such signals
C2 Explain how various sensors pick up the biomedical signals and convert them to a useful electronic signal within the measurement device.

LO2 Recognise the basic mathematical models for such systems
C1 Write down and analyse the mathematical equations for the components of biomedical electronics circuits.
C2 Apply the appropriate equations to solve Biomedical Engineering-oriented problems.

LO3 Understand the important electronic components in a modern biomedical measurement system
C1 For a given biomedical measurement system, describe the electronic components involved.
C2 For a given biomedical measurement system, explain the purpose and the operation of the electronic components involved.

LO4 Be able to specify a basic biomedical measurement system
C1 Demonstrate a holistic view of biomedical measurement systems.
C2 Predict and select the necessary components of a biomedical measurement system for a specific hitherto unseen application.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

Discussions around lecture topics, at tutorials and during the individual project work are used to assess student feedback on the course and also to guide students in their own work. A written individual report from each student is marked and there is a separate lab report to be written by each student as part of their assessment. A closed book exam completes the assessment.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	70%	1	30%		
LO1-LO4			LO2, LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Midway through the academic session

Resit Examination Procedures:

One 2-hour examination at the August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of a closed book exam.

Recommended Reading:

Reading material will be supplied as part of the module.

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE911 Engineering Science

Module Registrar: Dr Christopher McCormick	**Taught To:** MSc Biomedical Engineering	
Other Lecturers Involved: Prof Stuart Reid, Dr Mario Giardini and Mr Stephan Solomonidis	**Credit Weighting:** 20	**Semester:** 1
Compulsory/optional/elective class: Compulsory for students without and Engineering background.	**Academic Level:** 5	
Prerequisites: None		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
40	40			60	60	200

Educational Aim

This module aims to provide instruction in the areas of fundamental engineering (mechanics of rigid bodies, mechanics of deformable bodies, mechanics of fluids and electronics) for life scientists who have no formal education in the engineering sciences.

Learning Outcomes

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

LO1 Demonstrate knowledge and understanding of rigid body mechanics.

LO2 Demonstrate knowledge and understanding of the mechanics of materials.

LO3 Demonstrate knowledge and understanding of fluid mechanics.

LO4 Demonstrate knowledge and understanding of electronics.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:
Section 1 Mechanics of Rigid Bodies
Basic concepts – Force, moment, equilibrium
Free body diagrams, force components, acceleration
Friction, 3-D moments
Angular motion, centrifugal force, moment of inertia
Momentum, impulse, work done
Differentiation/integration. Work, energy, power
Jump laboratory – demonstration/data collection. Analysis of jump forces and impulse

Section 2 Mechanics of Deformable Bodies
Tension and Compression
Stress, strain; stress-strain relationships; elastic and plastic deformations; Young's modulus.
Yield stress, proof stress, ultimate tensile stress. Poisson's ratio. Analysis of compound bars. Tensile test laboratory.
Shear loading and torsion
Shear stress and strain; modulus of rigidity, shear strength.
Torsion of circular bars, angle of twist; polar moment of area, Analysis of compound shafts.
Bending of Beams
Bending moment and shear force distribution in beams. Calculation of bending stresses and strains, centroids and second moment of areas. Deflection of beams.
Design considerations
Failure and safety. Modes of failure. Ductile and brittle materials. Metal fatigue.

Section 3 Mechanics of Fluids
Fluids and their properties
Definitions, shear stress in a moving fluid, Newtonian and non-Newtonian fluids, viscosity.
Fluid properties – density, temperature effect on viscosity, surface tension, contact angle.
Fluid Statics
Pressure – Pascal's law for pressure at a point, variation in pressure within a static fluid.
Pressure and head. Pressure measurement techniques.
Fluid Dynamics
Basic concepts – uniform and steady flow, streamlines and stream tubes, laminar and turbulent flow, Reynolds number
Conservation of mass and energy in flow systems. Force-momentum equation. Bernoulli's equation. Analysis of flow in tubes – Poiseuille equation. Measurement of viscosity
Rheology of Blood

Factors affecting blood viscosity. Blood flow in capillaries, the Fahraeus-Lindqvist effect.

Section 4 Electronics
The Nature of Electricity
Charge, current and voltage. Voltage/current relationship across a resistive load. Ohm's Law.
Resistors in series and parallel.
Types of voltage signal: the function generator and the Cathode Ray Oscilloscope.
Capacitors and Inductors
Capacitance. Capacitors in series and parallel. Time constant.
Electromagnetic induction. Inductance and inductors.
AC Circuits
Concept of average and RMS representation of electrical power.
AC across resistive, capacitative and inductive loads. Power supplies.
Semiconductors
Semiconductors materials. Diodes and transistors. Transistor as an amplifier and as a switch.
Digital circuits.
An introduction to OP amps

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Demonstrate knowledge and understanding of rigid body mechanics.
C1 Describe the main principles (i.e. Newton's laws) of rigid body mechanics.
C2 Apply the appropriate equations to solve Biomedical Engineering-oriented problems.
LO2 Demonstrate knowledge and understanding of the mechanics of materials.
C1 Describe the main principles of the mechanics of materials.
C2 Apply the appropriate equations to solve Biomedical Engineering-oriented problems.
LO3 Demonstrate knowledge and understanding of fluid mechanics.
C1 Describe the main principles of fluid mechanics.
C2 Apply the appropriate equations to solve Biomedical Engineering-oriented problems.
LO4 Demonstrate knowledge and understanding of electronics.
C1 Describe the main principles electronics.
C2 Apply the appropriate equations to solve Biomedical Engineering-oriented problems.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

Regular tutorial sessions will deliver high quality feedback situations providing not only clear guidance on the expected level of performance but also good data about how students are progressing which will help shape future teaching.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			4	4 x 25%		
			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Coursework deadlines: 4 assessments will be conducted, one in each of rigid body mechanics, electronics, deformable bodies and fluid mechanics, during the delivery of the class. The submission dates for these will be staggered to balance workload across the first seven weeks of the semester.

Resit Examination Procedures:

Resit Assessment Procedures: exam only in August.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will ensure that all learning outcomes have been achieved and will therefore consist of either an exam or submission of additional courseworks, with the precise procedure dependent on the first attempt results.

Recommended Reading:

Applied Mechanics by J Hannah & MJ Hillier, 3rd Edition, Longman Scientific & Technical, 1995 ISBN 0-582-25632 1

Additional Student Feedback:

MODULE DESCRIPTION FORM

BE912 Anatomy and Physiology

Module Registrar: Dr Chris McCormick	**Taught To:** MSc Biomedical Engineering	
Other Lecturers Involved:	**Credit Weighting:** 10	**Semester:** 1/2
Compulsory/optional/elective class: Compulsory for students with a degree in a life science subject but have inadequate knowledge of anatomy and physiology.	**Academic Level:** 5	

Prerequisites: None

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
Online					100	100

Educational Aim

This module aims to provide a student with the basic knowledge of the anatomical structure of the major body systems, together with an understanding of their physiological functioning.

Learning Outcomes

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

LO1 Identify the differences between tissues, organs and systems.

LO2 Describe the basic structure and function of the skeleton, joints, muscle and nervous tissue.

LO3 Describe the structure and function of the respiratory, cardiovascular, muscular and nervous systems and the co-ordination between these systems.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The syllabus comprises 13 online lectures covering the fundamentals of human anatomy and physiology. The content covers the following topics.

Basic General Human Anatomy

The skeletal system.

Muscle anatomy and physiology

Neurophysiology and Biophysics of Cells

Neuroanatomy

The cardiovascular system

The respiratory system

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Identify the differences between tissues, organs and systems.
C1 Name, locate and describe the anatomy and function of the main organs of the body.
C2 Name, locate and describe the anatomy function of the main tissues of the body.
C3 Describe the operation of multiple organs in a physiological system.

LO2 Describe the basic structure and function of the skeleton, joints, muscle and nervous tissue.
C1 Describe the basic structure and function of the musculo-skeletal system.
C2 Describe the basic structure and function of the diarthroidal joints.
C3 Describe the basic structure and function of nervous tissue.

LO3 Describe the structure and function of the respiratory, cardiovascular, muscular and nervous systems and the co-ordination between these systems.

C1 Describe the physiology of the respiratory system.
C2 Describe the physiology of the cardiovascular system.
C3 Describe the physiology of the nervous system.
C4 Describe the physiology of muscles.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

It is expected that this class will only be offered when necessary, and consequently it will only be to a small number of students (< 3) each year. Accordingly, direct interaction by the course organiser with individual students will be available.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	100				
LO1-LO3						

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

N/A

Resit Examination Procedures:

Exam in August.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

Fundamentals of Anatomy and Physiology; 10th Edition, Martini, Nath & Bartholomew Pearson International Edition ISBN-10: 1292057602

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE914 Biomedical Engineering Dissertation

Module Registrar: Dr Asimina Kazakidi			**Taught To:** PgDip Biomedical Engineering			
Other Lecturers Involved: All BME academic staff			**Credit Weighting:** 20		**Semester:** 3	
Compulsory/optional/elective class: Optional			**Academic Level:** 5			
Prerequisites: BE919 Research Methodology						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
			200			200

Educational Aim

This module aims to provide an opportunity for students to experience the challenges and rewards of sustained, independent study in a topic of their own choice in the general field of Biomedical Engineering. It will involve students in a number of processes which may include justification of the selected topic; selecting, devising and applying appropriate methods and techniques; anticipating and solving problems which arise; displaying knowledge of background literature; and evaluating and reporting the conclusions of the study. The dissertation is likely to take the form of a literature review. This project work will have been supported by a compulsory research methods module and specialist knowledge classes throughout the year designed to assist with technical aspects of methodology and analysis.

Learning Outcomes

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

LO1 Demonstrate a critical understanding of the principal theories, principles and concepts of their chosen topic field.

LO2 Show autonomy in planning and executing a significant review of the literature.

LO3 Apply critical analysis, evaluation and interpretation of published work.

LO4 Effectively communicate specialist knowledge in their chosen field to technically adept non-specialists.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

There is no formal syllabus to this module. Supervisors will guide students through an appropriate research process.

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 **Demonstrate a critical understanding of the principal theories, principles and concepts of their chosen topic field**.
C1 Describe the appropriate theoretical background for their project, including any underlying assumptions.
C2 Describe alternative theories/methodologies where appropriate and discuss the differences between approaches.
C3 Provide a fully-informed justifiable rationale for their research.

LO2 **Show autonomy in planning and executing a significant review of the literature**.
C1 Collect relevant literature appropriate to the review.
C3 Demonstrate knowledge of the literature by reporting the salient issues.

LO3 **Apply critical analysis, evaluation and interpretation of published work**.
C1 Critically appraise the collated literature.
C2 Synthesise the literature and provide an original interpretation of the collected information.

LO4 **Effectively communicate specialist knowledge in their chosen field to technically adept non-specialists.**
C1 Use a good standard of technical English
C2 Explain complex concepts with clarity of expression.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

Regular student-supervisor meetings will deliver regular high quality feedback on progress providing ample opportunity for students to understand and to attain the expected level of achievement. Students will be working within a project area of their choice maintaining motivation and interest in their work. Whilst independent, a healthy research buzz within the Bioengineering Unit provides a motivational learning community with peer-peer encouragement and support in addition to that from the supervisor.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
					1	100
					LO1-LO4	

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

End of July

Resit Examination Procedures:

Students who fail to provide a satisfactory project at the first attempt will be asked to do corrections and to resubmit within an agreed timescale.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module.

Recommended Reading:

Individual supervisors will recommend initial reading. It is then up to the student to direct themselves in collating the appropriate literature.

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE915 Medical Science for Engineering

Module Registrar: Dr Junxi Wu	**Taught To:** MSc/MRes/PgDip/PgCert Biomedical Engineering	
Other Lecturers Involved: Dr Michelle McLean; Dr Danial Kahani and Dr Craig Childs.	**Credit Weighting:** 20	**Semester:** 1
Compulsory/optional/elective class: Compulsory for students without a life science background.	**Academic Level:** SHE 5	

Prerequisites: None

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
66	6				128	200

Educational Aim

To provide students of Biomedical Engineering with instruction in key areas of human anatomy, physiology and cell biology relevant to the advanced study of bio- and clinical engineering. We aim to provide understanding of normal biological function and control as derived from scientific and clinical evidence. The course will educate students to use knowledge of normal function to better understand pathology, disease diagnosis and treatment.

Learning Outcomes

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

LO1 Have knowledge and understanding of cellular organization, function and metabolism.

LO2 Have knowledge and understanding of human anatomy in relation to each major body system and the structural composition of the human body.

LO3 Have knowledge and understanding of the main physiological systems and the control processes than underpin normal function.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Main theme: Normal function supplemented with information of disease states and pathologies.

Cell Biology:
Lecture classes will examine the principal features of cellular organisation, differentiation, division, signalling and metabolism, the structure and functions of the extracellular matrix and basic molecular biology. Classes will also examine the constituents of blood, the process of blood cell formation and the body's defence mechanisms.

Anatomy:
Anatomy classes will examine the structural organisation of the tissues of the human body with emphasis on the musculoskeletal system, the divisions of the nervous system and the major organ systems..

Physiology:
Instruction in integrative physiology will introduce students to the main physiological systems and teaching will be strongly linked to lessons in anatomy. With the emphasis on function the physiological component of the course will identify the major control mechanisms that operate to regulate body function. The course will examine physiological processes at multiple levels of organization ranging from the sub-cellular to the intact human. Modern concepts and theories on membrane biophysics, neural control, sensation and movement, the cardiovascular system, the respiratory system, fluid balance and digestion will be provided.

Where possible lectures will be supplemented with laboratory demonstrations

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Have knowledge and understanding of cellular organization, function and metabolism.
C1 Describe the basic biochemistry of the metabolic processes in cells.
C2 Describe the process of cell division, differentiation and their control through signalling pathways.
C3 Describe the composition/structure of epithelial and connective tissues of the body.
C4 Describe the composition and function of blood and of the immune system

LO2 Have knowledge and understanding of human anatomy in relation to each major body system and the structural composition of the human body.
C1 Describe the relationships that exist between biological structure and function and demonstrate knowledge of anatomical terminology, body and organ topography.
C2 Report on the variety of tissue types found in the human body.
C3 Describe at micro and macro levels the structures of the musculoskeletal system and their actions
C4 Provide descriptions of the organ systems their general organisation.

LO3 Have knowledge and understanding of the main physiological systems and the control processes than underpin normal function.
C1 Understand the concept of homeostasis and its importance in biological control systems.
C2 Describe the structure and biophysics of the cell membrane and the ionic basis of the electrical activity of excitable tissues (signal generation, propagation and communication)
C3 Detail the main sensory and motor pathways within the central nervous system and describe sensory and motor function in relation to voluntary and involuntary neuronal behaviour
C4 Describe the physiology of muscle function.
C5 Describe the regulation and co-ordination of the cardiac cycle and the maintenance of the circulation.
C6 Understand the principles of gas exchange across tissues, CO_2 and O_2 transport in the blood and the regulation of ventilation.
C7 Understand the role of the kidney in fluid balance regulation.
C8 Describe the major functions of the liver and the gastrointestinal system.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

At each stage in the curriculum student engagement is encouraged through interaction with the course tutors and on discussions on key biological principles presented to students for the first time. Tutorials aim to support learning and instant feedback is provided on understanding and comprehension of course content.

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

Class Test			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
3	120 min	100%				

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

No Coursework.

Resit Examination Procedures:

If first attempt average mark over all class tests is less than 50 student will re-sit failed individual component exams at the next exam diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

Fundamentals of Anatomy and Physiology; 11th Edition, Martini, Nath & Bartholomew Pearson
International Edition ISBN-10: 1292057602

Additional Student Feedback:

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

Tutorials will be arranged if required with individual student groups.

MODULE DESCRIPTION FORM

BE916 Introduction to Biomechanics

Module Registrar: Professor Philip Rowe	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved:	**Credit Weighting:** 10	**Semester:** 1
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	

Prerequisites:

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
10	16	4		20	50	100

Educational Aim

This module aims to provide the student with a tool set of analytical skills to enable them to undertake valid biomechanical analyses of human movement, including the science, engineering and mathematical skill to produce kinematic and kinetic analyses of human movement and the external and internal load actions experienced by humans during activity. The module will provided generic analysis skills but examples will focus primarily on human gait.

Learning Outcomes

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

LO1 Employ biomechanical principles and numerical methods to solve biomechanical problems.

LO2 To formulate biomechanical analyses and to appraise the results of such analyses.

LO3 To appraise current biomechanical technology and methodology and estimate future advances in such methods and technology.

LO4 Evaluate the role of biomechanics in understanding human movement and judge its likely impact on the design of medical and rehabilitation devices and the implementation and evaluation of rehabilitation technologies.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Newtons laws
Body segment parameters
Force and motion analysis
Kinematics and Kinetics
Numerical analysis of displacement data
Use of load transducers
Gait and intersegmental moments
Gait demonstration/data collection
Hip force analysis
Knee force analysis
Analysis of 3-D geometry
3-D motion analysis
3-D matrix mathematics
3-D definition of human joints

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Employ biomechanical principles and numerical methods to solve biomechanical problems.

C1 Comprehend and apply the concepts of forces, moments, displacement, velocity & acceleration in both linear and angular contexts and how they are related by Newtons laws.

C2 Create suitable free body diagrams of forces and moments of typical biomechanical problems.
C3 Construct suitable mathematical solutions for these diagrams.

LO2 To formulate biomechanical analyses and to appraise the results of such analyses.
C1 To design suitable strategies for the solution of these problems.
C2 To deploy the learnt mathematical techniques to solve these problems.
C3 To evaluate the results of these solutions and interpret there implications for human movement and health.

LO3 To appraise current biomechanical technology and methodology and estimate future advances in such methods and technology.
C1 To distinguish different types of biomechanical technology and methodology.
C2 To compare and contrast such technology and methodology.
C3 To assess its current and future abilities and potential.

LO4 Evaluate the role of biomechanics in understanding human movement and judge its likely impact on the design of medical and rehabilitation devices and the implementation and evaluation of rehabilitation technologies.
C1 To appraise the role biomechanics has played in the understanding of human movement.
C2 To appraise the role biomechanics has played in advancing healthcare.
C3 To estimate its likely future impact on healthcare.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/
Specific details relating to this class are as follows:

An e-learning Myplace website will be used to facilitate learning, assessment and feedback. The website will include all teaching material, powerpoint copies of lectures, tutorial examples and worked answers, a previous exam paper with answers and suggested links to other learning resources. The website will also include pre module revision information and suggestions for further reading. Assignments will be directly relevant to current material and a feedback sheet giving the marks will be used to return performance to students. Interaction between staff and students and dialogue relating to delivered material will be encouraged in lectures, tutorials and laboratories and an online chat facility will be included in the web package. Clear instructions will be given to students regarding the assignments in both written and verbal format.

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

Exam			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	70%	1	30%		
			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

To be announced.

Resit Examination Procedures:

Coursework resubmission prior to August Diet and resit exam in August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of resit exam and coursework resubmission.

Recommended Reading:

Research methods in biomechanics
D. Gordon E. Robertson 1950-
Champaign, IL : Human Kinetics c2004
Main Library 6 Week Loan (D 591.1852 RES)
Functional human movement : measurement and analysis
Brian R Durward; Gillian D Baer; Philip J Rowe
Oxford ; Boston, Mass : Butterworth-Heinemann 1999
Main Library 6 Week Loan (D 612.76 FUN)
Biomechanics of the musculo-skeletal system
Benno Maurus Nigg; W Herzog (Walter), 1955-
2nd ed. Chichester ; New York : Wiley c1999

Available at ML Main Library 6 Week Loan (D 612.76 BIO)
Basic biomechanics of the musculoskeletal system
Margareta Nordin; Victor H Frankel (Victor Hirsch), 1925-
3rd ed. Philadelphia : Lippincott Williams & Wilkins c2001
Main Library 6 Week Loan (D 612.76 NOR)
Biomechanics and motor control of human movement
David A. Winter 1930-
3rd ed. New Jersey : John Wiley & Sons 2004
ML Main Library 1 Week Loan (D 612.76 WIN)
Fundamentals of biomechanics : equilibrium, motion, and deformation
Nihat Özkaya 1956- Margareta Nordin
2nd ed. New York : Springer c1999
ML Main Library 6 Week Loan (D 612.76 OZK)
Biomechanical basis of human movement
Joseph Hamill 1946- Kathleen Knutzen
2nd ed. Philadelphia : Lippincott Williams & Wilkins c2003
Main Library 1 Week Loan (D 612.76 HAM)

Additional Student Feedback:

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

Weeks 12

Feedback will also be given electronically through the module Myplace e-learning package following the relevant exam board.

MODULE DESCRIPTION FORM

BE918 Professional Studies in Biomedical Engineering

Module Registrar: Dr Craig Robertson				**Taught To:** PGDip/MSc/MRes Biomedical Engineering		
Other Lecturers Involved: Guest lecturers				**Credit Weighting:** 10	**Semester:** 1/2	
Compulsory/optional/elective class: Compulsory				**Academic Level:** SHE 5		
Prerequisites: None						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
12	6			12	70	100

Educational Aim

This module aims to:

- Provide an introduction to the philosophy, ethics and methodology of research;
- Outline the role that the bioengineer plays in the solution of clinical problems;
- Provide training in the principles, assessment and application of safety procedures in areas relevant to medical physics and biomedical engineering; and
- Engender an awareness of the importance of regulatory issues in medical device design and manufacturing.

Learning Outcomes

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

LO1 Appreciate the role that professional bodies play in society, and the various pathways that exist to becoming a professionally qualified engineer; have knowledge of the standards of competence and integrity to which professional engineers in the UK are held (UK-SPEC), and the role that biomedical engineers, in particular, play in finding solutions to clinical problems.

LO2 Recognise and understand hazards, relevant safety procedures and legislation in a broad range of activities encountered in medical physics and biomedical engineering.

LO3 Compare and contrast the quality management systems in place in industry with the requirements of medical device manufacture; and to provide an overview of the regulatory framework in which these companies operate.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The healthcare science workforce: overview of career pathways for healthcare scientists and engineers in Universities and the NHS

The research landscape: the scientific literature; good practice in research; research ethics: structure and conduct of clinical trials

Management of Health & Safety in the work-place:

Health & Safety Legislation

Fire safety

Chemical Safety: COSHH, hazards, storage, use & disposal

Electrical Safety: fault conditions, leakage currents, circuit protection, body response to electrical shock

Biological Safety: blood and other tissues, handling procedures, contamination and cross-contamination, cleaning; infection control

Ionising Radiation: sources, units, physical and biological effects, measurement and instrumentation, dose limits, protection, legislation

Non-ionising Radiation: UV, lasers, ultrasound, physical and biological effects, dose limits, legislation

Quality Management Systems: comparison of industry-based and clinical design management systems;

Manufacturing and quality control (ISO9001); good manufacturing practices

Regulatory issues in medical device manufacture: device classification; registration and listing; declaration of conformity (the CE mark)

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Appreciate the complexity of the research landscape, its constraints and challenges, and the role that bioengineers in particular play in finding solutions to clinical problems.
- C1 Articulate the importance ethical issues in scientific and clinical research;
- C2 Identify the type of projects that require ethical review by a University or NHS Research Ethics Committee;
- C3 Ability to identify the procedures in order to obtain ethical approval for research involving human subjects in both university and NHS settings; and the roles of the chief investigator, sponsor, etc.
- C4 Outline the career paths open to scientists and engineers in biomedical research.

LO2 Recognise and understand hazards, relevant safety procedures and legislation in a broad range of activities encountered in medical physics and biomedical engineering.
- C1 Ability to identify and weigh the risks and hazards associated with laboratory- and clinical-based activities;
- C2 Outline the assessment and reporting procedures to be followed to ensure a safe working environment; and
- C3 The relevant health and safety legislation and the executive bodies involved in enforcing those regulations.

LO3 Compare and contrast the quality management systems in place in industry with the requirements of medical device manufacture; and to provide an overview of the regulatory framework in which these companies operate.
- C1 Ability to identify principles of Medical Device Design;
- C2 Identify the requirements specific to medical device design and manufacture;
- C3 Identify the relevant quality management systems, standards and regulations that apply; and
- C4 The relevant medical device legislation and the executive bodies involved in enforcing those regulations.

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

Principles of Assessment and Feedback

The module is wholly formative, student outcomes being assessed using tools provided by the University's Virtual Learning Environment 'MyPlace'; and on campus (where possible); the VLE will be used also to promote interaction between individual students and their tutors, and to tailor feedback on performance to individual students.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			3	100		
			LO1-LO3			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

An online MCQ test will be set in Week 11 of Semester 1.
A number of self-assessment exercises will be set in Week 6 with deadlines by Week 11 of (Semester 1).

Resit Examination Procedures:

Resubmission of failed coursework as per 1st attempt.

PLEASE NOTE:
Students need to gain a summative mark of 50% in the class test and complete all formative assessments in order to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Recommended Reading:

Electronic resources:
Links to appropriate on-line learning resources and exercises will be provided on MyPlace

Additional Student Feedback:

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

Beginning of second semester (via MyPlace).

MODULE DESCRIPTION FORM

BE919 Research Methodology

Module Registrar: Dr Christopher McCormick	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Dr Michelle Maclean	**Credit Weighting:** 10	**Semester:** 1
Compulsory/optional/elective class: Compulsory	**Academic Level:** SHE 5	

Prerequisites: None

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
18	5	16			61	100

Educational Aim

This module aims to equip the students with the knowledge and skills necessary for undertaking a research project. Students will gain an understanding of aspects including experimental design, research writing skills, and the use of mathematics and statistics tools including software for data visualisation and analysis, all of which are needed to progress in their research in Biomedical Engineering.

Learning Outcomes

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

LO1 Demonstrate knowledge and understanding of the various design possibilities for a research project, the different types of data that can be generated, and demonstrate knowledge of how to select a data sample.

LO2 Demonstrate knowledge and understanding of the most common methods for visualising and analysing categorical and continuous data, including regression methods and probability.

LO3 Demonstrate understanding of when particular estimation and inference methods are appropriate and how to interpret their results.

LO4 Demonstrate the ability to appropriately utilise the various methods of data presentation and statistical analysis when writing scientific reports.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

Section 1: Producing Data
- subsection 2.1: Sampling
- subsection 2.2: Designing Studies

Section 2: Exploratory Data Analysis
- subsection 1.1: Examining Distributions
- subsection 1.2: Examining Relationships

Section 3: Probability
- subsection 3.1: Introduction (Probability)
- subsection 3.2: Random Variables
- subsection 3.3: Sampling Distributions

Section 4: Inference
- subsection 4.1: Introduction (Inference)
- subsection 4.2: Estimation
- subsection 4.3: Hypothesis Testing

Section 5: Scientific Writing
- subsection 5.1: Writing scientific abstracts and reports
- subsection 5.2: Presenting and reporting data and statistical analysis

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Demonstrate knowledge and understanding of the various design possibilities for a research project, the different types of data that can be generated, and demonstrate knowledge of how to select a data sample.

C1 Identify a range of experimental design methods, and the level of measurement in different research studies.

C2 Recognise and compare important considerations for observational and randomised trials.

C3 Describe how to select a data sample and estimate the size of a sample required for a particular research study.

C4 Differentiate between different types of data generated in a particular research study.

LO2 Demonstrate knowledge and understanding of the most common methods for visualising and analysing categorical and continuous data, including regression methods and probability.
C1 Describe the main principles of visualising and analysing data generated in research studies
C2 Apply the appropriate methods to visualise and analyse data generated in research studies
C3 Interpret and assess results after analysing data.

LO3 Demonstrate understanding of when particular estimation and inference methods are appropriate and how to interpret their results.
C1 Construct a research hypotheses and identify a claim
C2 Apply appropriate inference methods to test a research study hypothesis
C3 Interpret results from hypothesis testing

LO4 Demonstrate the ability to appropriately utilise the various methods of data presentation and statistical analysis when writing scientific papers/reports.
C1 Apply knowledge learnt to construct a scientific abstract and prepare a research paper/report
C2 Present, report and interpret data and statistical analysis within a research paper/report

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

- Clear instructions will be given to students about assessment requirements and expectation through lecture/tutorial sessions and written notes.
- Students will work on a regular basis on a series of tasks within tutorials and computer labs, where there are opportunities for interaction and dialogue around learning (with their peer group and teaching staff). Each of these tasks will be followed by feedback to encourage self-assessment and reflection on their learning progress. Informal communities of learning may emerge from these activities.
- Interaction and dialogue around learning will be encouraged during tutorials, laboratory sessions and at the end of each lecture.
- Students will be given a choice of topic to explore for their project assessment, thus enabling this aspect of assessment to be tailored to their interests and motivations
- The opportunity to work through worked examples during lectures, together with conversations with students during tutorial/computer lab sessions, will provide information that will help that shape teaching in subsequent lectures. In particular, the revision lecture content will be shaped by such information.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			Class Test Computer worksheets	40% Pass/Fail	1	60%
			LO1-LO4		LO1-LO4	

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Students will sit a class test in week 8 (Semester 1)

One mini-project report to be submitted by 16th December 2022

All submission deadlines will also be communicated in class.

Resit Examination Procedures:

Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. Students will be required to be re-examined on the element that they failed (class test or mini-project, or both).

Recommended Reading:

Access to comprehensive lecture slides and notes will be provided during the class. Students wishing to carry out additional reading to supplement their learning may wish to consult some of the following texts, which provide a broad range of approaches to the study and application of statistics within a biomedical context.

R. Ennos, *Statistical and Data Handling Skills in Biology*, Pearson Education Ltd
C. Dytham, *Choosing and using statistics - a biologists guide*, Wiley-Blackwell
D.G. Altman *Practical Statistics for Medical Research,* Chapman and Hall
J.M. Bland *An Introduction to Medical Statistics,* Oxford
B.R. Kirkwood and J.A. Sterne *Essential Medical Statistics,* Blackwell
Ryan, BF & Joiner, *MINITAB handbook*, Duxbury – Kent

Additional Student Feedback:

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

Feedback will be provided after the revision class test (before the Class test in Week 10, Semester 1).

Feedback on the mini-project will be provided at the start of Semester 2.

Further details on the feedback session will be announced via Myplace and in class, once these are known.

MODULE DESCRIPTION FORM

BE920 The Medical Device Regulatory Process

Module Registrar: Dr Craig Robertson	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Edwin Lindsay, Professor Terry Gourlay	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class:	**Academic Level:** SHE 5	
Prerequisites: None		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
20	5			45	30	100

Educational Aim

This module aims to give students an understanding of the regulatory pathway and requirements to deliver a new medical device to the marketplace from concept to clinical use. The student should understand the complexity of the regulatory requirements internationally, the importance of the maintenance of technical files and pre and post-certification vigilance.

Learning Outcomes

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

LO1 Understand the need for regulatory approval.

LO2 Have a clear understanding of device classifications.

LO3 Be aware of the need for the construction and maintenance of the technical file.

LO4 Have an understanding of the different regulatory requirements across international sectors.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:
The background to the regulatory approval system together with the underlying need and benefits.
Device classification and its impact on device testing requirements.
How to construct a device technical file and the importance of its maintenance.
The role of the academic in the regulatory process.
The different regional approval processes the levels of approval and international reciprocation.
The cost of the regulatory process.

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Understand the need for regulatory approval.
C1 Review the history of the regulatory process
C2 Discuss the need for a regulatory process for medical devices and the clinical and commercial drivers.

LO2 Have a clear understanding of device classifications.
C1 Examine the different classifications of devices and how these impact on the regulatory process.
C2 Discuss the complexity of the investigative process for each classification

LO3 Be aware of the need for the construction and maintenance of the technical file.
C1 Review the process of constructing a technical file.
C2 Discuss the role of the technical file in the regulatory process, where it begins and where it ends.
C3 Review examples of technical files and critically discuss good practice

LO4 Have an understanding of the different regulatory requirements across international sectors.
C1 Demonstrate a full understanding of the requirements for CE approval and FDA submission.
C2 Compare and contrast the processes for adverse event reporting internationally.
C3 Critically discuss the level of reciprocation across international regulatory bodies.
C4 Appraise the regulatory audit process form the regulatory body's perspective and that of the manufacturer.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

Discussions around lecture topics, at tutorials and during the individual project work are used to assess student feedback on the course and also to guide students in their own work. There will also be individual written essays.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	70%	1	30%		
LO1-LO4			LO1-LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Coursework will be set in week 7 of semester 2, with submission in week 13.

Resit Examination Procedures:

2 Hour examination in August diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

There are many textbooks available on the subject of regulatory affairs in the medical device domain. However, these will be reviewed as part of the course materials and if it becomes clear that a particular textbook covers all of the subject matter at the correct level it will become recommended reading for the start of the course.

Additional Student Feedback:

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

Week 6 and 12.

MODULE DESCRIPTION FORM

BE923 Haemodynamics for Engineers

Module Registrar: Dr Asimina Kazakidi	**Taught To:** MSc/MRes Biomedical Engineering; MSc/MRes Biofluid Mechanics	
Other Lecturers Involved: Assignment tutors	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Elective	**Academic Level:** 5	
Prerequisites:		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
18				12	70	100

Educational Aim

Haemodynamics is that branch of hydraulics which concerns the flow of blood in arteries; and insofar as the laws of fluid mechanics may be applied to the study of blood flow in arteries, knowledge of the structural and functional properties of the heart and circulation, and the flow characteristics of blood, is essential if these equations are to be applied appropriately. In presenting the fluid mechanics of the circulation in terms that are familiar to students of mechanical and electrical engineering, the module aims to give students an insight into the complexities of blood flow, and how the laws of fluid mechanics relate to the flow of blood in health and disease, and the design of cardiovascular prostheses and devices, in particular. The basic principles underlying the measurement of blood pressure and flow will be explored in relation the diagnosis and treatment of cardiovascular disease.

Learning Outcomes

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

LO1 identify appropriate governing equations and apply them to obtain solutions to clinical problems relating to the flow of blood in the body and in cardiovascular devices;

LO2 relate the physical properties of the vessel wall and whole blood to their structure and composition (visco-elastic behaviour; the role of formed elements of blood, etc.); and

LO3 understand the principles of operation of instrumentation used to measure blood pressure and flow, including the rheological properties of whole blood.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

Fundamental principles of fluid mechanics: the flow of ideal fluids, viscous fluids; conservation of mass and volume, momentum and energy: the Bernoulli and Poiseuille equations; steady pressure-flow relations; Ohm's law and vascular resistance

Blood rheology: viscous properties of whole blood and plasma (Newtonian and non-Newtonian flows): the Power Law and Casson models

The heart and circulation: ventricular elastance, P-V loops; structure, composition and physical properties of the arterial wall

Pulsatile pressure-flow relations: vascular impedance, wave propagation and transmission-line theory; lumped-parameter models of the circulatory system

Why measure blood pressure and flow? Clinical blood flow measurement techniques, pressure and flow sensors

Blood flow in health and disease, and in relation to cardiovascular prostheses and devices: heart valves, cardiac assist devices, arterial bypass grafts, extracorporeal devices for haemodialysis and blood oxygenation

Assessment of Learning Outcomes

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

LO1 Identify appropriate governing equations and apply them to obtain solutions to clinical problems relating to the flow of blood in the body and in cardiovascular devices:
- C1 Demonstrate knowledge and understanding of the laws of fluid mechanics as applied to the flow of blood, and the assumptions that apply;
- C2 Apply the appropriate equations to the solution of blood flow through vascular and cardiac-valve prostheses;

C3 Understand how the elastic properties of the vessel wall to the propagation of the pressure pulse from the heart to the peripheral vasculature; and
C4 Draw analogies from electrical circuit theory to describe the relationship between pressure and flow in the circulatory system.

LO2 Relate the physical properties of the vessel wall and whole blood to their structure and composition:
C1 Demonstrate knowledge and understanding of the contributions of blood plasma and the formed elements to the viscous behaviour of whole blood;
C2 Distinguish between Newtonian and non-Newtonian flow behaviour, and the models used to describe such behaviour; and
C3 Understand the implications of phase separation and the Fahraeus and Fahraeus-Lindquist effects on haematocrit, and the flow behaviour of cellular suspensions such as whole blood.

LO3 understand the principles of operation of instrumentation used to measure blood pressure and flow, including the viscous properties of whole blood:
C1 Demonstrate knowledge and understanding of the principles of viscometry as embodied in the capillary tube and rotational instruments used to determine the viscous properties of fluids;
C2 Understand the principles of operation of transducers used to measure blood pressure and flow, and
C3 Demonstrate an awareness of the limitations of such transducers (in terms of frequency response, signal-to-noise ratio, hysteresis) in relation to the measurement of physiological signals.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

The module includes both formative and summative assessments, student outcomes being assessed by means of coursework and based on electronic resources provided by the University's Virtual Learning Environment 'MyPlace' and internet; simulation software available to students of the University on site licence (Matlab/Simulink). MyPlace will be used also to promote interaction between individual students and their tutors, and to tailor feedback on performance to individual students; likewise, student feedback will be sought to improve both content and delivery of the course.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			4	30%, 30%, 10%, 30%		
			LO 1-3			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

To be arranged.

Resit Examination Procedures:

Resubmission of failed coursework.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Recommended Reading:

Textbooks:

Snapshots of hemodynamics: an aid for clinical research and graduate education (N Westerhof, M Noble) Springerlink (electronic access)

McDonald's Blood Flow in Arteries: Theoretical, Experimental and Clinical Principles; 6th edition (WW Nichols and others), CRC Press, London, 2011 (electronic access)

Mechanics of fluids, 8th edition (BS Massey, AJ Ward-Smith), Taylor & Francis, London, 2006 (electronic access)

Electronic resources:

Links to appropriate on-line learning resources will be provided on MyPlace

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE924 Medical Robotics

Module Registrar: Dr W Shu				**Taught To:** MSc/MEng Biomedical		
Other Lecturers Involved:				**Credit Weighting:** 10		**Semester:** 2
Compulsory/optional/elective class: Optional				**Academic Level:** 5		
Prerequisites:						
Module Format and Delivery (hours):						
Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
20	10			24	46	100

Educational Aim

This module aims to introduce the concepts and the design of medical robotics and its applications in various medical disciplines including, interventions, surgery and rehabilitation. The course focuses on fundamental principles such as kinematics, dynamics, control and artificial intelligent combined with medical applications and examples.

Learning Outcomes

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

LO1 Assess various design, kinematics, dynamics and control features of medical robotics systems

LO2 Appraise the clinical applications of medical robotic systems, their operational concepts and their clinical environments

LO3 Design medical robotic systems using mathematical and simulation models

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

1. An introduction to the various applications of medical robotics
2. The design rationale for medical robotics
3. Kinematics of medical robotics
4. Denavit-Hartenberg Convention
5. Basic dynamics and control
6. Mechatronic systems
7. Man-machine interfaces
8. Surgical planning, tracking and navigation
9. Clinical applications
10. Development of medical robotic products

Assessment of Learning Outcomes

Criteria

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Assess various design, kinematics, dynamics and control of medical robotics systems
C1 Describe the basic design methods for medical robotic systems
C2 Be able to calculate the kinematics of robotic manipulators
C3 Be able to build basic dynamic and control model for medical robotic manipulators

LO2 Appraise the clinical applications of medical robotic systems, their operational concepts and their clinical environments
C1 Defend the function and application of medical robotics in various medical fields
C2 Analyse various clinical requirements and evaluate their influence on medical robotics design

LO3 Recognise the basic mathematical and simulation models for these systems
C1 Be able to build D-H model for medical robotic manipulators
C2 Be able to build basic dynamic model using simulation and analysis software

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Specific details relating to this class are as follows:

12 hours of tutorials are provided to work through problems where teacher feedback is available when students get stuck. This ensures the feedback is timely. In the lectures and tutorials, the teacher will model in class how they would think through and solve 'exemplar' problems paying specific attention to the concepts behind the problems and the different solution strategies including incorrect pathways. This will clarify what good performance is.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hrs	70%	2	30%		
LO1-3			LO1-3			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Week 5 and Week 10

Resit Examination Procedures:

Exam only.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading:

Being a developing field, no text books cover the entirety of the course, however, students will be directed to journal articles which will provide necessary information.

Additional Student Feedback:

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

Session: Feedback sessions are provided for all MSc classes halfway in Semester 2.

MODULE DESCRIPTION FORM

BE925 Numerical Modelling in Biomedical Engineering

Module Registrar: Dr Asimina Kazakidi		**Taught To:** MSc Biomedical Engineering; MSc Prosthetics and Orthotics	
Other Lecturers Involved: Case study tutors		**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional		**Academic Level:** 5	

Prerequisites:
Some prior reading of programming basics will be provided in Semester 1 for those choosing this class

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
10		27			63	100

Educational Aim

This module aims to provide experience of using numerical modelling tools, in particular Matlab, in a Biomedical Engineering context. For those with no knowledge of matlab, some pre-class preparatory work will be required and expected.

Case studies will be presented from the departmental research portfolio that require the use of numerical modelling. These case studies will be explained in detail, together with a methodology of the required numerical modelling to answer the research question. Students will be expected to write their own code to answer the research question, to appropriately graphically present results and to interpret the results in context.

Learning Outcomes

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

LO1 Design numerical modelling tools to solve research-related problems in the field of Biomedical Engineering

LO2 Create appropriate methods of data presentation of structured data

LO3 Interpret numerical solutions to address research question(s) in the context of the presented case studies.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

Structured and supported self-learning will develop numerical modelling tools and techniques. Case studies will introduce both generic and specific numerical skills abilities, in addition to introducing a knowledge based on the case study itself. Case studies will require different graphical presentation methods, which will be exemplified.

Assessment of Learning Outcomes

Criteria

LO1 Design numerical modelling tools to solve research-related problems in the field of Biomedical Engineering
C1 Production of numerical code that follows a given algorithm
C2 Appropriate using of programming structures (e.g. for loops, functions, while etc)

LO2 Create appropriate methods of data presentation of structured data
C1 Use of 2D and 3D data plotting appropriate to context

LO3 Interpret numerical solutions to address research question(s) in the context of the presented case studies.
C1 Concisely relate programming output to research question
C2 Critically assess findings with regards to literature evidence
C3 Comment of differences and suggest further improvements, if necessary

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/
Specific details relating to this class are as follows:

Two small short assignments should encourage students to spend time and effort on the class.

Computer laboratories will provide students the ability to self-learn through the use of online help documentation and a process of trial and error. Teacher feedback will be provided as and when the student needs it: good quality teacher feedback should ultimately be geared to helping students learn to trouble-shoot and self-regulate their own

performance. It should be timely –ideally it should be available when students are 'stuck', when it will have maximum impact and in time to improve subsequent assignments.
Submitted short reports should enable staff turnaround in marking and feedback of submissions to enable students to close gap between desired and current performance.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			2	100% (50% each)		
			LO1-3			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Submission in weeks 9 and 11.

Resit Examination Procedures:

Resubmission of failed coursework.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Recommended Reading:

MATLAB [internet resource] a practical introduction to programming and problem solving, Stormy Attaway Elsevier 3rd ed. Waltham, MA : Butterworth-Heinemann Ltd 2013

Essential MATLAB for engineers and scientists [internet resource] Brian D. Hahn author. Daniel T. Valentine 1946- author.; Elsevier Fifth edition. Waltham, MA : Academic Press 2013

Contextualised reading for case studies will be provided by the case study leader.

Additional Student Feedback:

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

MODULE DESCRIPTION FORM

BE928 Rehabilitation Technology

Module Registrar: Dr Andrew Kerr	**Taught To:** MSc Biomedical Engineering	
Other Lecturers Involved: Online resources	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class:	**Academic Level:** M	
Prerequisites: Nil		

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
11	22	7	20	20	120	200

Educational Aim

This module aims to:

Provide students with the evidence and rationale for embedding technology into rehabilitation practice considering the technological, design and cultural barriers to adoption.

Learning Outcomes

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

LO1 Justify the use of rehabilitation technologies within a modern health service.

LO2 Apply understanding of rehabilitation principles to the design of technologies.

LO3 Analyse the design features of rehabilitation technologies.

LO4 Appraise currently technologies within a specific area of rehabilitation in terms of efficacy and usability.

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications.)

Syllabus

The module will teach the following:

1) Broad principles of rehabilitation including strengthening, flexibility, neuroplasticity and motivation (3 weeks).
2) Application of design techniques (e.g. user centred design) to rehabilitation technology (1 week).
3) The gamification of rehabilitation activities, role of competition and fun (1 week).
4) Principles of motor learning (1 week).
5) Body worn sensors to provide movement feedback (0.5 weeks).
6) Virtual reality in rehabilitation (0.5 weeks).
7) Robotics in rehabilitation (0.5 weeks).
8) Brain Computer interface technology (0.5 weeks).
8) Barriers to adoption (1 week).
9) Case studies from neurological and musculoskeletal conditions. (2 weeks)

Assessment of Learning Outcomes

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

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Justify the use of rehabilitation technologies within a modern health service.
C1 Economic backdrop to health care and rehabilitation.
C2 Examples of technology already adopted in health care.
C3 Maturity of technologies such as body worn sensors and mobile devices (smart phones etc).

LO2 Apply understanding of rehabilitation principles to the design of technologies.
C1 Principles of musculoskeletal adaption to loading/movement.
C2 Principles of neuroplasticity with reference to motor (re)learning.
C3 Presentation of clinical case studies and discussion of literature.
C4 Appraising the use of therapy robots and virtual reality in rehabilitation.

LO3 Analyse the design features of rehabilitation technologies.
C1 Exposure to design techniques such as user centred design and controlled convergence.
C2 Student based learning through searching patents, reviews, research publications.

C3 Use of feedback and development of a gaming environment suitable for rehabilitation.

LO4 Appraise current technologies within a specific area of rehabilitation in terms of efficacy and usability.
C1 Barriers to adoption.
C2 Presentation of case studies.
C3 Planning and reading for assessments.

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

Principles of Assessment and Feedback

The University's Assessment and Feedback Policy can be found at: www.strath.ac.uk/staff/policies/academic/

Please state briefly how these are incorporated in this module.

Online forums will be set up for each weekly topic to encourage engagement across the study group. Student will have an opportunity to have a one to one discussion regarding their assessment (project proposal) plans with the teaching. Each student will be provided with a detailed feedback on their assessment based on assessment criteria provided in week 1.

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

Examination			Coursework		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			2	100		
			Coursework 1 assesses LO3 and LO4 Coursework 2 assesses LO1 and LO2.			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

1) Coursework 1: Submission of a pre-recorded, 10 minute video, of a presentation summarising the literature for a rehabilitation technology. This will be accompanied by a 350-word abstract short. (LO3 and LO4)
2) Coursework 2: A 1500 word proposal for developing a rehabilitation technology or enhancement of a current one (LO1 and LO2)

Resit Examination Procedures:

Resits will be resubmissions of the original work following feedback.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Recommended Reading:

There are few core textbooks in this area so the reading will be predominantly journal based.

The first 3 weeks will consider principles of rehabilitation supported by:

1) Physical Management in Neurological Rehabilitation, Stokes and Stack (2011). Churchill Livingstone
2) Motor learning: concepts and applications. Magil (2003). McGraw-Hill

The use of technology in neurological conditions will be covered by:

Neurorehabilitation technology. (2012) Dietz et al. Springer-Verlag, London.

Additional Student Feedback:

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

USE OF COMPUTING FACILITIES AND RESOURCES

Find and use IT or AV | University of Strathclyde

Library & IT help | University of Strathclyde