DEPARTMENT OF BIOMEDICAL ENGINEERING

University of Strathclyde Engineering

MRes in Biomedical Engineering

Student Handbook

Session 2020 – 2021

WELCOME

From the Head of Department

Dear All

On behalf of all members of staff, I welcome you to the Department of Biomedical Engineering. We hope you will have an enjoyable and successful time with us.

In light of the ongoing Covid19 pandemic, our first priority remains the health and safety of all our students and staff. This has been at the forefront when making plans for this session and it will continue to guide our plans during the weeks and months ahead. We are determined that you have the best University experience possible, and encourage you to keep updated regularly with the campus guidelines, which are informed at all times by Government advice.

The Course is divided into two Semesters of instructional classes followed by a full-time research project. Those intending to obtain an MSc will have a four-month research project; those intending to obtain a Postgraduate Diploma have the option of a two-month research project.

This handbook explains the organisation and regulations affecting the MSc and PgDip Courses. The MSc in Biomedical Engineering is accredited by the Institute of Physics and Engineering in Medicine (IPEM). IPEM is the professional body for Clinical Scientists working in Medical Physics and Clinical Engineering and organizes training for career clinical scientists in the National Health Service. Part I of the training scheme requires the acquisition of an IPEM-accredited MSc.

StrathLife – The Student Journey
This handbook should be read in conjunction with 'everything you need to know about student life' which can be found here:

www.strath.ac.uk/studywithus/strathlife/

This provides information on the range of support and information services within the University.

Dr Christopher McCormick (Room 875. Level 8, Graham Hills Building), extension 3438, 0141 548 3438, christopher.mccormick@strath.ac.uk), as Course Director, will be your main point of contact and will help with any academic issues you may have.

Please note: Welcome and Development week starts on Monday 14th September with an introduction lecture at 10:00. You should have received an invitation to this lecture by email and I look forward to meeting you at that time. There will be a range of activities for you to engage in during this week. Teaching on your semester 1 classes will then start on Monday 21st September. The first five weeks of semester 1 will be delivered on-line before moving to a blended learning approach to delivery. Further information on this will be communicated to you in due course.

Commented [CM1]: Feel free to check these updates with Stuart, I thought they were necessary for clarity on the first few weeks of activity for the students.

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 students 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 MRes is predominantly taught by the staff in the Department of Biomedical Engineering. The following 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 Christopher McCormick	christopher.mccormick@strath.ac.uk	3438
DEPUTY DIRECTOR and ADVISOR OF STUDIES		
Dr Melina Kazakidi	asimina.kazakidi@strath.ac.uk	3228
COURSE ADMINISTRATOR		
Ms Maureen Leonard	m.b.leonard@strath.ac.uk	5920
COURSE TEACHING STAFF		
Dr Richard Black	richard.black@strath.ac.uk	4568
Dr Craig Childs	craig.childs@strath.ac.uk	2228
Dr Peter Childs	peter.childs@strath.ac.uk	
Prof Patricia Connelly	patricia.connolly@strath.ac.uk	3034
Dr Damion Corrigan	damion.corrigan@strath.ac.uk	3294
Dr Mario Giardini	mario.giardini@strath.ac.uk	3042
Prof Terry Gourlay	terence.gourlay@strath.ac.uk	2005
Dr Danial Kahani	danial.kahani@strath.ac.uk	
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 Mairi Sanderson	mairi.sandison@strath.ac.uk	3842
Mr Stephanos Solomonidis	s.e.solomonidis@strath.ac.uk	3778
Dr Junxi Wu	junxi.wu@strath.ac.uk	2505
Dr Wei Yao	w.yao@strath.ac.uk	3030
DEPARTMENT DISABILITY CONTACT		
Dr Craig Robertson	craig.a.robertson@strath.ac.uk	3030

Commented [CM2]: Please add:
Dr Peter Childs
Prof Patricia Connolly
Prof Stuart Reid
Dr Damion Corrigan
Dr Mairi Sandison
Dr Junxi Wu

OVERVIEW OF MRES BIOMEDICAL ENGINEERING

MRes students are required to undertake instructional classes and complete a research project. For the degree, students must attain 60 credits from the instructional classes and obtain a further 120 credits on satisfactory completion of a thesis on a research project.

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 the following pages. 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. This interview will also discuss your optional class choices.

Early in Semester 1, a list of available research projects will be published. You should speak with potential supervisors about the projects that you are interested in and submit a form indicating your 1st, 2nd and 3rd choices. Projects will be allocated shortly thereafter.

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 6 of Semester 2 you are required to submit an abstract of your project and in week 6 of Semester 2 you will be required to make an oral presentation of your project, outlining the programme of research you are undertaking and the work to date. Your project supervisor will advise you on the preparation of the abstract and oral presentation.

Full time work on your project proceeds in Semester 2, although students, may be still attending clases during this semester depending on their choice of elective classes. Following the completion of project work, MRes students are required to submit a thesis. The submission date for MRes students will be around the middle of August. The theses will be examined by an internal examiner and an external examiner appointed by the supervisor with approval from the HOD. In early September, MRes students may be required to attend an oral examination of their thesis.

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 MRes Biomedical Engineering

Code	Class Name	Semester	Credits	Organiser
Initial Classes (one of):				
BE915	Medical science for engineering	1	20	Dr Damion Corrigan
or				
BE911	Engineering science	1	20	Dr Phil Riches
Compulsory classes:				
BE918	Professional Studies in Biomedical Engineering	1	10	Dr Richard Black
BE919	Research Methodology	1	10	Dr Chris McCormick
Optional Classes (2 to be taken for MRes):				
BE916	Introduction to Biomechanics	2	10	Prof Phil Rowe
BE902	Prosthetics and Orthotics	2	10	Stephan Solomonidis
BE901	Regenerative Medicine and Tissue Engineering	2	10	Dr Chris McCormick
BE900	Tissue Mechanics	2	10	Dr Phil Riches
BE909	Biomedical Electronics	1	10	Prof Patricia Connolly
BE904	Clinical and Sports Biomechanics	2	10	Prof Phil Rowe
BE906	Biomaterials and Biocompatibility	2	10	Dr Richard Black
BE903	Cardiovascular Devices	2	10	Prof Terry Gourlay
BE908	Biomedical Instrumentation	1	10	Dr Mario Giardini
BE920	The Medical Device Regulatory Process	2	10	Prof Terry Gourlay
BE923	Haemodynamics for Engineers	2	10	Dr Richard Black
BE924	Medical Robotics	2	10	Dr Wei Yao
BE925	Numerical Methods in Biomedical Engineering	2	10	Dr Melina Kazakidi
BE928	Rehabilitation Technology	2	10	Dr Andrew Kerr
Independent research class:				
BE913	MRes Project	1, 2 and 3	120	??????

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

Please note that due to timetabling issues students can only do optional classes BE923 or BE904: BE924 or BE903 and BE925 or BE920.

GENERAL NOTES

Graham Hills Building Access

The normal hours of access to Graham Hills 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 MRes 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

Familiarising yourself with the emergency routes from the building and the location of fire alarm call points and fire-fighting equipment in advance of any fire alert 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.

The Departmental Safety Officer is Mr Brian Cartlidge, room 4.02, extension 3283 or 0141 548 3283.

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 may also require assignments to be uploaded to MyPlace for assessment purposes, including Turnitin a plagiarism detection software.

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

http://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 foyer, office areas and the tea 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:
https://www.strath.ac.uk/professionalservices/media/ps/isd/isd20/policydocuments/University_Policy_on_the_Use_of_Computing_Facilities_and_Resources.pdf

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 (Dr Craig Robertson, craig.a.robertson@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/

www.strath.ac.uk/media/ps/strategyandpolicy/FINAL_GuideForStudents.pdf

Departmental Disability Contact (DDC)
The designated DDC in the Biomedical Department is Dr Craig Robertson (Room GH860, extension 3030, 0141 548 3030)

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 week 1, however further mathematical work may be required in particular classes.

Attendance
It is expected that you will attend the University during all normal working days, i.e.

Monday to Friday 09:00 to 17:00 hours

When you have a taught class timetabled, it is expected that you to attend that class. . The attendance requirements for PGT elements of the course are 75% of lectures, and 90% of laboratory classes, unless there is a valid reason for non-attendance. 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.

Once a MRes project has been allocated to you, it is expected that the majority of time out with taught curriculum will be devoted to the project. Notwithstanding that requirement, project supervisors will understand the need for taught class independent study, coursework and revision.

Taught Classes 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.

Project Examination Procedure
You will submit a thesis which normally will be orally examined by an external (i.e. out with the Univeristy) and an internal examiner. The quality of the thesis and your performance in an oral examination will determine whether you obtain the credits for the project. NB You are expected to bring a copy of your thesis to the oral examination and this copy must be identical to the one the examiners have.

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 60 credits with the project adding a further 120 credits.

Resit Examinations
Students who fail any taught class (i.e. achieve a mark of less than 50%) shall be permitted one further attempt to pass the relevant class at the August diet of examinations.

If a student fails a class at the second attempt, they will be withdrawn and no award will be made.

The Award of MRes
Where a candidate has accumulated 60 credits of taught classes from the curriculum, together with 120 credits for the project, they will be awarded the MRes Biomedical Engineering.

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 outwith 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.

Maths Skills Support Centre
Phone: 0141 548 3343
Room LT308
Livingstone Tower
26 Richmond Street
Glasgow G1 1XH
For more information visit the Maths Skills Support Centre webpage.

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	40 percentage point penalty (10 for first day, 5 for second day, 5 for third day, 5 for fourth day, 5

	hours), student has no approved extension.	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 MRes Project
The MRes project thesis (two copies, soft bound) should be submitted to the Administration Office. The submission date will be in the middle of August. Late submission may mean that the thesis will not be examined in time for November graduation.

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.
http://www.strath.ac.uk/media/ps/cs/qmap/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 Study Skills Service, they offer practical advice and support to help you study more effectively. For example: reading and writing tips, grammar and language help, time management, exam preparation and critical thinking.
These can be accessed here: www.strath.ac.uk/studyskills/

The Univerity 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:

moss.strath.ac.uk/developmentandtraining/resourcecentre/Pages/Home.aspx

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: https://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: www.strath.ac.uk/professionalservices/library/

COURSE REGULATIONS

These regulations are DRAFT and subject to change

20.42 DEPARTMENT OF BIOMEDICAL ENGINEERING

MRes in Biomedical Engineering
MRes in Biomedical Engineering with Biomechanics
MRes in Biomedical Engineering with Cell and Tissue Engineering
MRes in Biomedical Engineering with Medical Devices
MRes in Biomedical Engineering with Prosthetics and Orthotics Technologies

[These regulations are to be read in conjunction with Regulations 20 and 20.4]

ADMISSION

20.42.1 Regulations 20.4.1 and 20.4.2 shall apply.

DURATION OF STUDY

20.42.2 Regulations 20.4.5 and 20.4.6 shall apply.

MODE OF STUDY

20.42.3 The course is available by full-time and part-time study.

CREDIT TRANSFER AND RECOGNITION OF PRIOR LEARNING

20.42.4 At the discretion of the Head of Department, **or Course Director** credit transfer and RPL may be granted for up to 34% of the course.

CURRICULUM

20.42.5 All students shall undertake an approved curriculum as follows:

Compulsory Classes		Level	Credits
BE918	Professional Studies in Biomedical Engineering	5	10
BE919	Research Methodology	5	10
BE913	MRes Project	5	120
Either			
BE911	Engineering Science	5	20
or			
BE915	Medical Science for Engineering	5	20

dependent on the academic background of the student and chosen after consultation with the Course Director.

For the degree of MRes in Biomedical Engineering with Biomechanics			
BE916	Introduction to Biomechanics	5	10
No fewer than 1 optional class		5	10

For the degree of MRes in Biomedical Engineering with Cell and Tissue Engineering			
BE901	Regenerative Medicine & Tissue Engineering	5	10
No fewer than 1 optional class		5	10

For the degree of MRes in Biomedical Engineering with Medical Devices			
BE920	The Medical Device Regulatory Process	5	10
No fewer than 1 optional class		5	10
For the degree of MRes in Biomedical Engineering with Prosthetics and Orthotics Technologies			
BE902	Prosthetics and Orthotics	5	10
No fewer than 1 optional class		5	10
BE902	Prosthetics and Orthotics	5	10
No fewer than 1 optional class		5	10
For the degree of MRes in Biomedical Engineering			
No fewer than 2 optional classes		5	20
Optional Classes			
No fewer than 20 credits chosen from:			
BE916	Introduction to Biomechanics	5	10
BE902	Prosthetics and Orthotics	5	10
BE901	Regenerative Medicine & Tissue Engineering	5	10
BE900	Tissue Mechanics	5	10
BE909	Biomedical Electronics	5	10
BE904	Clinical and Sports Biomechanics	5	10
BE906	Biomaterials and biocompatibility	5	10
BE903	Cardiovascular Devices	5	10
BE908	Biomedical Instrumentation	5	10
BE920	The Medical Device Regulatory Process	5	10
BE923	Haemodynamics for Engineers	5	10
BE924	Medical Robotics	5	10
BE925	Numerical Modelling in Biomedical Engineering	5	10
BE928	Rehabilitation Technoligy	5	10

Examination, Progress and Final Assessment

20.42.6 Candidates are required to pass written examinations and to perform to the satisfaction of the Board of Examiners in the course work and in the project.

20.42.7 Candidates will normally be expected to perform to the satisfaction of the Board of Examiners in the **compulsory** taught components of the course before being permitted to proceed to the project.

20.42.8 Candidates who fail to satisfy the Board of Examiners in any taught class shall be permitted one further attempt to pass the relevant class(es) normally in the same academic year.

AWARD

20.42.9 **Degree of MRes**: In order to qualify for the award of the degree of MRes in Biomedical Engineering, a candidate must have performed to the satisfaction of the Board of Examiners and must have accumulated no fewer than 180 credits, of which 120 must have been awarded in respect of the project.

TRANSFER

20.42.10 A candidate who fails to satisfy the progress or award requirements for the

degree of MRes in Biomedical Engineering may be transferred to the Postgraduate Certificate in Biomedical Engineering provided the appropriate progress regulations are satisfied.

20.42.11

to 20.42.20 (Number not used)

Academic Year

University of Strathclyde Academic Calendar 2020-21

Date Week Commencing	University & Timetabling System Weeks	University Holidays	Academic Calendar
Mon 03/08/2020	1		Resit Exams
Mon 10/08/2020	2		Resit Exams
Mon 17/08/2020	3		
Mon 24/08/2020	4		
Mon 31/08/2020	5		
Mon 07/09/2020	6		
Mon 14/09/2020	7		Welcome and Development Week
Mon 21/09/2020	8		Wk 1 Semester 1
Mon 28/09/2020	9	Mon 28.09.20	Wk 2
Mon 05/10/2020	10		Wk 3
Mon 12/10/2020	11		Wk 4
Mon 19/10/2020	12		Wk 5
Mon 26/10/2020	13		Wk 6
Mon 02/11/2020	14		Wk 7
Mon 09/11/2020	15		Wk 8
Mon 16/11/2020	16		Wk 9
Mon 23/11/2020	17		Wk 10
Mon 30/11/2020	18		Wk 11
Mon 07/12/2020	19		Semester 1 Exams
Mon 14/12/2020	20		
Mon 21/12/2020	21	Thu 24.12.20 to	Christmas Vacation
Mon 28/12/2020	22		Christmas Vacation
Mon 04/01/2021	23	Mon 04.01.21	Christmas Vacation
Mon 11/01/2021	24		Consolidation and Development Week
Mon 18/01/2021	25		Wk 1 Semester 2
Mon 25/01/2021	26		Wk 2
Mon 01/02/2021	27		Wk 3
Mon 08/02/2021	28		Wk 4
Mon 15/02/2021	29		Wk 5
Mon 22/02/2021	30		Wk 6
Mon 01/03/2021	31		Wk 7
Mon 08/03/2021	32		Wk 8
Mon 15/03/2021	33		Wk 9
Mon 22/03/2021	34		Wk 10
Mon 29/03/2021	35	Fri 02.04.21	Wk 11
Mon 05/04/2021	36	Mon 05.04.21	Spring Break
Mon 12/04/2021	37		Spring Break
Mon 19/04/2021	38		Semester 2 Exams
Mon 26/04/2021	39		
Mon 03/05/2021	40	Mon 03.05.21	
Mon 10/05/2021	41		
Mon 17/05/2021	42		
Mon 24/05/2021	43		
Mon 31/05/2021	44	Mon 31.05.21	
Mon 07/06/2021	45		
Mon 14/06/2021	46		
Mon 21/06/2021	47		
Mon 28/06/2021	48		
Mon 05/07/2021	49		
Mon 12/07/2021	50	Fri 16.07.21	
Mo 19/07/2021	51	Mon 19.07.21	
Mon 26/07/2021	52		

TIMETABLE FOR WELCOME AND DEVELOPMENT WEEK

There is a separate timetable for the first week of the first semester. It is important you attend on Monday morning at 09:30. 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 MRes.

Welcome and Development Week (Mon 14th - Fri 18th September)									
	9am	**10am**	**11am**	**12pm**	**1pm**	**2pm**	**3pm**	**4pm**	**5pm**
Monday		**Welcome Talk** (Dr McCormick)			**Getting Started with Online Learning** (Dr McCormick)		UK Biomedical Engineering Launch Event		
Tuesday		Exponentials and Logarithms (Dr McCormick)			Research Overview (CM)		Trigonometry (Prof Rowe)		
Wednesday		Differentiation (Prof Reid)				Intergration (Dr Riches)			
Thursday		Module Choice Interviews				Module Choice Interviews			
Friday						Matrices (Dr Kazakidi)		Welcome Reception	

Live Zoom Session
Independent Activity
Live Zoom Session
Individual Interview
Live Zoom Session
External Online Event

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 28 September is a public holiday.

MODULE DESCRIPTORS

The following pages detail the individual classes (modules) that may be taken as part of the MRes 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
BE906 Biomaterials and biocompatibility
BE908 Biomedical instrumentation
BE909 Biomedical electronics
BE911 Engineering science
BE913 MRes Project
BE915 Medical science for engineering
BE916 Introduction to biomechanics
BE918 Professional studies in biomedical engineering
BE919 Research methodology
BE920 The medical device regulatory process
BE923 Haemodynamics for Engineers
BE924 Medical Robotics
BE925 Numerical Modelling in Biomedical Engineering
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:** 2
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 time-dependent mechanical properties of human tissue. The properties are incorporated into a FE model 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 Describe 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 (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. The use of a journal discussion will foster a sense of learning community.

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 12 Semester 2.

MODULE DESCRIPTION FORM

BE901 Regenerative Medicine and Tissue Engineering

Module Registrar: Dr Christopher McCormick	**Taught To:** MSc/PgDip/PGCert Biomedical Engineering	
Other Lecturers Involved: Dr R A Black plus invited 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		12	12	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			Coursework		Group Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	40	1	30	1	30
LO1-LO4			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.

Coursework will be set in week 7 and submitted in week 10.

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: Mr Stephan Solomonidis	**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	7			12	51	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. 7 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 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:

First assignment should be handed in week 7 and the second one in week 12. Assignments will have been set 3 weeks prior.

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. Hand outs 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)

Thursday weeks 6 and 12, Semester 2.

MODULE DESCRIPTION FORM

BE903 Cardiovascular Devices

Module Registrar: Professor T Gourlay	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Mrs Ida Torrance and Mr Mark Danton (Yorkhill Hospital), Mr Nawar Al Attar (Golden Jubilee) Prof David Wheatley, Dr Monica Rozeik, Dr Craig Robertson, Dr Chris McCormick and Dr Wei Yao	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Optional	**Academic Level:** SHE 5	

Prerequisites:

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
20	5	5	20	20	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 types and applications of VAD 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:

- 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.
- 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)
- History, current status and future of cardiovascular stents.
- The regulatory process governing the clinical deployment of cardiovascular devices and materials.
- Aspects of safety related to the clinical use of cardiovascular devices.
- An individual project around the design of a safety enhanced system for extracorporeal life support.

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.
C3 Describe the limitations, advantages and drivers associated with the development and deployment of percutaneous heart valves.

LO4 Understand the different types and applications of VAD technologies.
C1 Describe the different types of VAD devices.
C2 Explain the different techniques used to deploy VAD devices and how these effect patient mobility and the treatment cycle.
C3 For a given clinical condition, select the appropriate VAD device 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/
Specific details relating to this class are as follows:

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		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
1	2 hours	60%	3	15% (3x5%)	1	25%
LO1-LO4			LO1-LO3		LO1-LO4	

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

Coursework / Submissions deadlines:
Three coursework assignments will be set in weeks 3, 7, 9 with submission in two weeks. A project will be set in week 5, with submission in week 12.

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)

Friday week 6 and 12.

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

BE906 Biomaterials and Biocompatibility

Module Registrar: Dr Richard Black	**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

BE908 Biomedical Instrumentation

Module Registrar: Dr Mario E Giardini	**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
28				22	50	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 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 coursework. Examination will be by closed book examination, but further assessment will be undertaken through assessment of assignments and reports.

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 6 week 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: Professor Patricia Connolly	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Drs O'Leary and Windmill	**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
20	5	5	20	20	30	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 Assesment 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:

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	5%	1	25%
LO1-LO4			LO1-LO3		LO1-LO4	

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

Coursework / Submissions deadlines:

January of the academic session.

Resit Examination Procedures:

Students will reattempt failed assessments for the August assessment 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:

The interdisciplinary nature of this course would require purchase of several textbooks. Thus extensive printed hand outs are supplied with detailed course notes.

Additional Student Feedback:

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

Wednesday, Week 12, Semester 1.

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

BE913 MRes Project

Module Registrar:	**Taught To:** MRes Biomedical Engineering	
Other Lecturers Involved: All BME Academic/Research Staff	**Credit Weighting:** 120	**Semester:** 1,2&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 will 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 with peers, more senior colleagues and specialist 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 original research question.
C2 Execute the developed methodology.
C3 Critically appraise the execution of the methodology.

LO3 **Apply critical analysis, evaluation and interpretation 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 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 (2) providing ample opportunity for students to understand and to attain the expected level of achievement (3). Students will be working within a project area of their choice (8) maintaining motivation and interest in their work. Whilst independent, a healthy research buzz within the Biomedical Engineering Unit provides a motivational learning community (10) 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	100
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 is mid-August. An oral examination will take place in early September.

Resit Examination Procedures:

Students who fail to provide a satisfactory project at the first attempt will be asked to do corrections until the supervisor deems it of suitable standard.

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)

Feedback will be provided by regular discussions between student and individual supervisors.

MODULE DESCRIPTION FORM

BE915 Medical Science for Engineering

Module Registrar: Dr Damion Corrigan	**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 Richard Black	**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'; 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 a deadline in Week 1 of Semester 2.

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 and Dr Damion Corrigan		**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
15	5	10			70	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: Exploratory Data Analysis
- subsection 1.1: Examining Distributions
- subsection 1.2: Examining Relationships

Section 2: Producing Data
- subsection 2.1: Sampling
- subsection 2.2: Designing Studies

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			Class Test		Project	
Number	Duration	Weighting	Number	Weighting	Number	Weighting
			1	40%	1	60%
LO1-LO4 (resit only)			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 10 (based on class running from week 6-11)

One project report to be submitted at the end of week 11 of semester 1.

All submission deadlines will also be communicated in class.

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:

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)

Tuesday, Week 11, Semester 1.

Session: 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: Professor Terry Gourlay	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved: Edwin Lindsay, Dr Mario Giardini Dr Monica Kerr	**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/

Specific details relating to this class are as follows:

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 Richard Black	**Taught To:** MSc/MRes Biomedical Engineering	
Other Lecturers Involved:	**Credit Weighting:** 10	**Semester:** 2
Compulsory/optional/elective class: Elective	**Academic Level:** SHE5	

Prerequisites: BE911 Engineering Science (MSc/MRes students) or equivalent first degree fluid mechanics course

Module Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	Total
12	6			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/

Specific details relating to this class are as follows:

The module includes both formative and summative assessments, student outcomes being assessed by means of examination 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
1	3 hrs	60	1	40		

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:

Resit and/or resubmission of coursework as per 1st attempt.

PLEASE NOTE:

Students need to gain a summative mark of 50% *(please delete as appropriate)* 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:

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 Wei Yao	**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

1. **Scope**

This policy covers the use of all computing facilities and resources administered by the University of Strathclyde, including use by staff and students of the University and by any other person authorised to use these facilities, and use at the University's property and/or through any networked links to the University's computing facilities. Anyone using any kind of computer hardware or software, for any purpose, at the University, even if it is their own equipment and even if it is only connected to the institution through a network, is required to abide by the terms of this policy.

In this policy 'computing facilities and resources' includes central services such as those provided by Information Services through the Divisions of Information Systems and Networking and Computing Services, and through the Centre for Educational Systems and AV Media Services; the University Libraries; departmental computers; microcomputers and peripherals; personal computers, whether desktop or portable, when linked to facilities provided by the University; any associated software and data including data created by others, and the networking elements which link the facilities together.

2. **Introduction**

The University of Strathclyde provides a wide range of computing facilities and resources for use by staff and students in pursuit of teaching, learning, research and administration. Use of the facilities solely for the purposes of the University is encouraged as part of the University's strategy of ensuring that any use the University makes of information technologies will be for the improvement of our already high educational standards.

Use of computing facilities requires that individuals accept certain responsibilities as set out in this policy (see section 5 - Conditions for Use). The University recognises that new measures are required for managing information in electronic forms, much of which will represent the University as a first point of contact with the rest of the world. The underlying philosophy of this policy is that the University's computing facilities should be used in a manner which is ethical, legal, appropriate to the University's aims, and not to the detriment of others. The policy sets out the conditions for use of the University's network for the publication of all material and demands that the same sensitivity is applied to information in electronic format as is normally applied to the written work.

3. **Access to Facilities**

3.1 Computing facilities are provided by the Department of Information Services and others for the University as a whole, and by Faculties and Departments for their staff and students, solely for use by staff and students in connection with the aims and purposes of the University (see section 4 - Definitions). Computing facilities should not be used for personal or recreational purposes.

3.2 On special application being made, the University may authorise the use of its computing facilities for work outside the scope of normal University purposes, including consultancy and use by external users. Any charges for provision of such facilities will be determined by the Director of Information Services. Other use may be allowed, by agreement with the Director of Information Services, as a privilege not a right and if abused may be deemed to be a breach of this policy.

3.3 In order to use the computing facilities of the University of Strathclyde a person must first register with the Department of Information Services as an authorised user in the manner prescribed in this policy. Registration grants authorisation to use some or all of the facilities of the University. Access to facilities is normally arranged by allocation of a unique user ID (sometimes called a login or user name) and will require the production of a University ID card or other form of identification. On most computer systems a password is required to gain access. Users should choose a password that is secure and not easily guessed, and should keep it secure at all times.

3.4 If a user suspects that the security of their computing facilities has been breached or compromised it should be reported to Information Services Help Desk or departmental computing staff as soon as possible.

3.5 Bona fide visitors to the University such as the staff of institutions connected to JANET (Joint Academic Network) and visiting scholars from overseas can request access to the University's computing facilities. Appropriate arrangements will be made by the Department of Information Services to register them as an authorised user in the normal way.

3.6 The Director of Information Services may permit other legal entities to connect to the University network under the terms and conditions laid down in the United Kingdom Education and Research Networks Association (UKERNA) document "Sponsored and Proxy Connections to JANET Guidelines for Hosting Organisations".

4. Definitions

In this policy the following definitions apply:

Accessing means holding, storing, displaying, transmitting, or distributing information in electronic format, by whatever means, such that others may have access to it or use it; and such that the publisher or source of the information may be traced back the University of Strathclyde.

Authorised means a person who has been registered as a user by the Department of Information Services in accordance with the procedures set out in section 3 or a separate legal entity or bona fide visitor allowed connection under 3.5 and 3.6 above.

Computing Facilities includes:

All local computing facilities, multi-user systems, server systems, work stations, personal computers, micro computers and networks and or other electronic information and communication systems whether provided by the University or otherwise and which are intended wholly or partly for use by employees of, researchers at or students of the University or wholly or partly for use for other University related or academic purposes.

All remote facilities which are accessed through the computer, electronic information and communication facilities at or operated wholly or partly by the University and anything else deemed computing equipment by the University information includes words, pictures, data, graphics, visual images, video and sound clips and computer programs solely for University purposes means use by staff in connection with their normal University duties of employment and by students in connection with their approved University study or research unacceptable material includes material which, in the opinion of the University, is offensive, abusive, defamatory, discriminatory, obscene or otherwise illegal which brings or may bring the University into disrepute. The provision by a University user of explicit or cryptic links to such material stored elsewhere on the Internet is also unacceptable unless agreed with the Director of Information Services personal information means any information which is not sanctioned by the University in accordance with section 7 of this policy.

5. Conditions for Use – Rights and Responsibilities

5.1 All users will be required to sign an agreement to become a registered user of the University's computing facilities and resources and by so doing have understood and agreed to abide by the terms of this policy and other appropriate University regulations. Users must also comply with the provisions of any current UK or Scots law (see section 6 - Legal Framework) and will be held responsible for any and all activity on computing facilities which is initiated by their user ID. It is every user's responsibility to act in a manner which will not cause damage to computing facilities or adversely affect the performance of any service available on these facilities. Users should not allow any other person access to their user ID or password; use another person's user ID or password; or modify or interfere with information belonging to another user without their permission.

5.2 The University of Strathclyde will not permit the use of its computer facilities and resources for the access to or transmission of information which is considered by the University to be unacceptable; illegal; in breach of University policies, such as those on Equal Opportunities and Harassment; wasteful of resources; or not commensurate with the provision of facilities for legitimate educational purposes.

Examples of such unacceptable use may include:

Accessing or displaying pornographic material; stating defamatory opinions or views concerning individuals or organisations; accessing or displaying discriminatory material or material which encourages discrimination; engaging in games or chain E-mail; publishing information which is intended to misinform and thereby cause anxiety or inconvenience in another; unauthorised use of University logos, titles etc.; spamming; corrupting or destroying other users' data; violating the privacy of other users; disrupting the work of others; using JANET in a way that denies service to others; misuse of networked resources such as the introduction of viruses.

5.3 The University may actively monitor usage of University computer facilities and resources which includes monitoring the access to, publication or receipt of, any Internet materials by any user and reserves the right to remove or require the immediate removal from the University systems of any material which, in the opinion of the Vice-Principal or a depute to whom authority has been delegated is unacceptable (see section 4 - Definitions). It is University policy to provide information obtained by monitoring, when required to do so to the UKERNA CERT team or other relevant agency.

5.4 No user will by wilful or deliberate act jeopardise the integrity of the computing equipment, communications network, system programs or other stored information. No user will connect to the University network any piece of equipment which by its function could adversely affect the performance of the network without the prior agreement of the Director of Information Services. Any user connecting their own equipment to the University network agrees that by doing so the Director of Information Services has the right to audit the equipment and data stored on it at any time.

5.5 Users may only use JANET for the purposes which meet the conditions agreed by the Secretary of State for Education for the operation of the network, and as set out in the UKERNA document "JANET Acceptable Use Policy". Users must also comply with the provisions of the Code of Conduct for the Use of Software and Datasets at Higher Education and Research Council Establishments. This Code does not constitute a licence and, in all cases, users of software should acquaint themselves with the provisions of the relevant licence when they obtain a copy and before putting the same into use. Further information about JANET and the Code of Conduct is available from the Information Services Help Desk in the first instance.

5.6 At the request of the Director of Information Services, any user holding or transmitting encrypted data must provide corresponding decrypting tools to the Director of Information Services for investigation purposes. Any dispute arising over material of a commercial or militarily sensitive nature will be referred to the Vice-Principal for decision.

6. **Legal Framework**

Users should be aware of UK legislation which relates to computer use. Much of the electronic information in use by staff and students is likely to also be available world-wide and care should be taken that the laws of other countries are not infringed by this availability. Brief details of the relevant legislation is outlined below but those seeking further information should contact the Director of Information Services in the first instance. Users should note carefully that much of the legislation prescribes criminal penalties including fines and custodial sentences where an offence is committed.

6.1 Data Protection Act 1984

The Act prohibits the holding, processing or disclosure of personal data about others on computer, unless the user is properly registered under the terms of the Act and observes the principles of data protection. Use of such information is subject to the University's Data Protection Registration and information about this can be obtained from the University's Data Protection Officer on ext 2416 (JA). All users are responsible for ensuring that they comply with the terms of the Act.

6.2 Telecommunications Act 1984

The Internet makes use of the "public telecommunication system" as defined by the Act. Under the Act it is a criminal offence to send a message or other matter that is grossly offensive, indecent, obscene or menacing in character via the public telecommunication system or to send a false message for the purpose of causing annoyance, inconvenience or needless anxiety to another, and those found guilty could face a substantial fine or a term of imprisonment.

6.3 The Copyright, Designs and Patents Act 1988

The Act requires that the permission of the owner of the intellectual property must be sought before any use is made of it. It is therefore unlawful to use or copy any material without proper authorisation and this includes computer software. Penalties include unlimited fines and up to two years imprisonment. It should be noted that the University titles and logos are the property of this University and may only be used for official University documents.

6.4 Computer Misuse Act 1990

The Act makes it a criminal offence to access, attempt to access or encourage others to access computer material without proper authority or to make unauthorised modification of computer material. This would include 'hacking', the introduction of viruses and knowingly receiving or using material from an unauthorised user who has gained access to computer material. Penalties for conviction include up to five years imprisonment and/or a fine.

6.5 Obscene Publications Act 1959

The publication, which includes transmission over a network, whether for gain or not, of material intended to be read, heard or looked at which is such as to tend to deprave and corrupt persons having access to it is a criminal offence under this Act. Penalties include up to three years in prison.

6.6 Criminal Justice and Public Order Act 1994

This legislation consolidates the protection of minors by making it a criminal offence to possess pornographic or obscene material of or involving minors, or material considered to be excessively violent. In the context of computer facilities it applies to the transmission, receipt and storage of text, audio, graphic and manipulated images.

(Note: The Acts referred to in 6.5 and 6.6 above apply in England and Wales but not in Scotland where prosecutions for similar offences are mounted on the basis of common law as opposed to Statute).

6.7 Sex Discrimination Act 1975

The Act makes it unlawful to discriminate against others on the grounds of sex, gender and marital status and any information published or received via the Internet which discriminates or encourages discrimination is illegal.

6.8 Race Relations Act 1976

The Act makes it unlawful to discriminate against others on the grounds of race, colour, nationality, ethnic or national origin and any information published or received via the Internet which discriminates or encourages discrimination is illegal.

6.9 Laws of Defamation

Any publication of a statement, comment or innuendo about another individual or organisation which cannot be justified at law may render the author liable to an action for defamation.

6.10 International and EC Law

Users should be aware that material they produce and transmit may be available worldwide, and care should be taken to ensure that no international laws or treaties are contravened. Specific examples include importing specified materials from a country for which an embargo is in force, and exporting material legally obtained in the UK but which when accessed in another country may constitute an offence in that country. It also includes accessing material which though legally available in another country is illegal in the UK.

EC Law is constantly changing particularly in the areas of sex discrimination, harassment and unequal treatment. Increasingly EC Directives and regulations are being interpreted to afford protection to people who are discriminated against or harassed because of their sexuality. The information about the Sex Discrimination Act (see 6.7 above) should be read with this in mind.

6.11 Official Secrets Acts

Some work carried out under contract from the Government or its agencies may be subject to the provisions of this legislation. Any publication of material which contravenes obligations under this legislation is a criminal offence and punishable by imprisonment and/or a fine.

7. Publishing Information in Electronic Format

7.1 The Department of Information Services gives permission to staff and students to publish information on the University of Strathclyde World Wide Web information server under Regulation 6.11.13 (see University calendar). This Regulation allows the University to impose more stringent conditions than those usually applying to the use of computing facilities and the University has chosen to do so in the form of this policy.

7.2 Heads of Department have responsibility for ensuring that any information published electronically on behalf of their Department adheres to this policy. Any person who provides information for the Department must have the authority to do so from the Head of Department.

7.3 Staff or students may apply to the Department of Information Services to publish information on behalf of a University club, society or association but such an application must first have the approval of the Head of Department or Dean as appropriate, and the approval of the club, society or association.

7.4 Those who publish general University information, such as maps, events, descriptive or historical information about the University must obtain permission from the Office of Marketing and Communications. Guidelines to publishing in electronic format are available from that department and via the home page on the University's website. They make clear that University logos and titles are only to be used in conjunction with information on official institutional web pages approved by the University for publication.

7.5 Individuals are responsible for all information published through their personal computer account such as via WWW personal home page or Email contributions to discussion lists or bulletin boards. All the requirements outlined in this policy apply equally to publications on the World Wide Web (see particularly sections 5 and 6).

7.6 Information published by individuals must be declared as such and must not appear to be published on behalf of the University. To that end there must be a clear separation between University information and personal information and the latter should contain the following disclaimer: "The views and opinions expressed herein are strictly those of the author. The contents have not been reviewed or approved by the University of Strathclyde. They do not represent or reflect the views of the University of Strathclyde or anyone else associated with the institution and the University retains no liability for the content or layout". Anyone who registers in an external index an address for an electronic information system, such as a departmental server or personal home page, must ensure that it does not appear that their address is the principal access point for all University of Strathclyde systems. The home page of any externally registered WWW server, run on University of Strathclyde systems MUST contain a pointer to the University of Strathclyde home page. Information on or links to or from the University's official web pages must be authorised by the Communications Office.

7.7 Nothing must be published which might in any way bring discredit or harm to the University or its members or bring the University into disrepute. Personal opinions must not be published in any way which might make them seem to be those of the University.

7.8 Appropriate care must be taken in the presentation, content and management of information being published electronically. This includes:

- care in writing, proofing and layout
- following appropriate University presentational guidelines eg display of University crest/logo etc
- attribution of the source of the information - include author, contact name and address
- removal of out-of-date information
- restricting access to sensitive information
- editorial changes to documents in electronic format should only be made with the permission of the 'owner' of the document

7.9 The University's computing facilities must not be used for the placing or distribution of commercial advertisements without the express written permission of the Vice-Principal. Any non-commercial advertisements which do appear must comply with the Code of Practice for Advertisers, issued by the Advertising Standards Authority, which requires that all advertisements should be 'legal, decent, truthful and honest'.

8. Misuse - Penalties and Sanctions

8.1 Breaches of this policy by staff or students will be dealt with under the appropriate disciplinary procedures. Where this involves students it will normally be dealt with under the University regulations for Student Discipline (see Regulation 5 in the University Calendar). The University will accept no responsibility for the effect disciplinary action might have on a student's academic progress and achievement. Where members of staff are involved breaches will be dealt with under the appropriate disciplinary procedures. Where an offence may have occurred under criminal law it will be reported to the police or other appropriate authority.

8.2 Where appropriate, staff or students at the University of Strathclyde or other authorised users may have their use of the University's computing facilities immediately suspended pending an investigation by an authorised person in the University.

8.3 In the event of loss being incurred by the University or members of the University as a result of a breach of these regulations by a user, that user may be held responsible for reimbursement of that loss.

9. Monitoring and Review

The effectiveness of this Policy will be monitored by the Department of Information Services and will be formally reviewed by the University Court within twelve months of its adoption.