

## Outline of the coursework requirements for Part IIB 100% coursework modules 2017-18

### Group A: Energy, Fluid Mechanics, and Turbomachinery

#### 4A2 Computational Fluid Dynamics

Progress Check/Brief Report/Week 6 of Michaelmas term/25%

Coursework/Report/End of Michaelmas term/75%

**Mesh Generation and Preprocessing** (Coursework: approx 2 hours)

- Conversion to Fortran; examples of Fortran programs
- Mesh generation for simplified geometries (eg bend, nozzle, hump, airfoil)
- Preprocessing

#### 2-D Euler, Time Marching CFD Program

(Coursework: 5 mini-exercises of about 2-4 hours each, forming a 16 hour mini-project)

1. Finite volume discretisation, evaluation of fluxes. (4h)
2. Application of boundary conditions. (2h)
3. Time Iteration, simple LAX method. (2h)
4. Convergence & accuracy testing. (4h)
5. Enhancements, e.g. deferred corrections, Adams - Bashforth RK integration, use of energy equation. (4h)
6. Exploration of post-processing

#### 4A4 Aircraft Stability and Control

Flight tests on Cranfield Jetstream 31 flying laboratory. Assessment of static and dynamic stability based on flight test data. Design study for an automatic control system for the aircraft. A report on the stability assessment and design study forms the basis for module assessment. The flight tests will take place at the end of the Michaelmas term.

#### 4A7 Aerodynamics

- Aerofoil design/Report/Michaelmas term/50%
- Transonic Aircraft Design/Report/Michaelmas Term/50%

#### ***Greener by Design (Coursework, Dr C.A. Hall)***

The coursework consists of a choice of one from three case studies, based on the simple modelling above to study from the perspective of environmental impact the trade-offs associated with (A) design range; (B) cruise altitude; and (C) engine overall pressure ratio. It is intended that the case studies will be spreadsheet based.

### Group B: Electrical Engineering

#### 4B25 Embedded Systems for the Internet of Things

New for 17-18

**Coursework activity #1:** OLED display control over SPI exercise [10/100]

Obtain hands-on experience writing a device driver in C for an SPI peripheral, using the FRDMKL03 ARM board and the OLED display from the course hardware kit.

**Coursework activity #2:** Project proposal one-page report [4/100]

Identify an interesting engineering problem that can be addressed using an embedded system developed using the concepts, theory, techniques, and tools covered in this course.

**Coursework activity #3:** Power measurement using TI INA219 I2C device exercise [10/100]

Obtain hands-on experience writing a device driver in C for an I2C peripheral, using the FRDMKL03 ARM board and the TI INA219 daughterboard from the course hardware kit.

**Coursework activity #4:** Sensor interfacing from Lattice iCE40 FPGA exercise [10/100]

Obtain hands-on experience implementing a design in the Verilog hardware description language.

**Coursework activity #5:** Project interim report [6/100]

Present progress made towards final project goals, evaluate lessons learned so far, and obtain feedback and guidance on necessary plan adaptation.

**Coursework activity #6:** Project final report [60/100]

Present the problem addressed, approach employed, system implemented, and system evaluation.

## **Group C: Mechanics, Materials, and Design**

### **4C5 Design Case Studies**

There will be a coursework exercise linked to each of the case studies with multi-part written assignments, using computer software where appropriate.

## **Group D: Civil, Structural, and Environmental Engineering**

### **4D4 Construction Engineering**

Coursework:

(a) Construction earthwork and equipment: estimation of excavation soil volumes from drawings, earthwork production calculation, logistics planning for transporting earth materials and for road construction operations, and equipment economics.

(b) Underground construction (tunnelling), based on a real project: tasks are to establish station tunnel stability during construction, assess the risk of damage to a building of considerable historical interest, and design outline protective measures for the building.

(c) Design of ground instrumentation and monitoring schemes for a deep shaft.

### **4D13 Architectural Engineering**

- 20% for the group presentation of the design and the model on week 5
- 20% for group report on last day of term
- 60% for an individually authored report on developing an aspect of the design and analysis, to be submitted digitally on Moodle by each student by 4.00pm on the first day of the Lent Term.

## **Group E: Management and Manufacturing**

### **4E1 Innovation and Strategic Management of Intellectual Property**

Coursework assignment 100%.

Student will have to apply their knowledge gained in this module by developing an IP strategy for a company. An IP analysis of the company's own portfolio, those of relevant current and future competitors is a key element of the assignment. During the module the students will be introduced to a patent analytics software, which they will be able to use for the coursework. The coursework will comprise an individual 3,000 word report (+/- 10%) with max. 5 figures or tables, excluding references and appendices.

#### **4E3 Business Innovation in a Digital Age**

The 4E3 module will be assessed by the following means:

- **Written paper, individual** (65% of total mark). This component of the assessment is made up of a final term paper.
- **Presentation, individual** (10% of total mark). Presentation based on your individual paper and peer review.
- **Case study presentation and discussion, team** (25% of total mark). Presenting a case study (20%) and discussing another team's presentation (5%) during one of the sessions 3-7.

The individual paper assignment will include a 3,000-word paper on an agreed topic. Students will investigate and report on the effects of digital innovation in transforming a particular industry (e.g. digital goods in the entertainment sector, mobile applications in banking, etc.). Students are expected to apply the concepts discussed in the lectures. It is expected that students will, where appropriate, explicitly draw on the articles provided in the course as well as other relevant articles from their own research.

#### **4E4 Management of Technology**

For the coursework, students are required to research and write a report of approximately 3,000 words on a specific management of technology theme provided in the first lecture of the module. The report should draw upon module material supplemented with students' own research on both industrial practice & academic theory.

#### **4E5 International Business**

The individual assignment is the only form of assessment for this course and, as such, counts for 100% of the final grade.

##### ***Assignment Description***

You will investigate the "institutional distance" between two different countries of your choosing and make an informed recommendation for the internationalization strategy of a fictitious firm. The aim of the assignment is to provide you with the opportunity to directly apply the concepts learned during the course to an empirical setting and encourage you to critically reflect on the different manners in which firms can cross borders.

#### **4E6 Accounting and Finance**

##### ***100% Coursework on Accounting and Finance***

The Accounting section carries 50% of the mark and the Finance section the remaining 50%

Learning objective:

- After completing this coursework students should be able to construct a company's financial statements from a jumble of raw data.
- After completing this coursework students should be able to interpret a company's financial statements using financial ratios.
- After completing this coursework students should be able to understand how to identify and finance the investments companies undertake.
- After completing this coursework students should be able to understand why and how companies compensate their investors.

#### **4E11 Strategic Management**

Regarding the form of individual assessment, it will be 100% coursework (essay of 2,500 words)- Due Date: March 21st 2017

You will prepare a complete strategic analysis of the current and future prospects for a company of your choice. The paper should contain a comprehensive industry and market analysis, including a detailed analysis of relevant competitors, and conclude with strategic recommendations (including corporate and business strategies) for top management. The selection of companies for strategic analysis is entirely up to each student; however, firms in industries that are in transition or firms that are undergoing major strategic changes are potentially more interesting.

#### **4E12 Project Management**

In-class individual case discussion contributions (20%), Group case write-up (30%), Coursework work individual (50%).

### **Group F: Information Engineering**

#### **4F13 Probabilistic Machine Learning**

Each of the three pieces of course work carry an equal weight in the evaluation.

- Coursework 1 is about regression using Gaussian processes.
- Coursework 2 will be about Probabilistic Ranking.
- Coursework 3 is about the Latent Dirichlet Allocation (LDA) model.

### **Group G: Bioengineering**

#### **4G1 Mathematical Biology of the Cell**

##### ***Coursework activity #1: Analysis of noise in prokaryotic gene expression***

Cells often express genes in low copy numbers, leading to substantial variability in protein. In this coursework you will build a simple model of gene expression, analyse it mathematically and simulate a stochastic version of the model.

##### Learning objective:

- understand how to estimate fluctuation size in a stochastic system and limitations of analytic estimates;
- be able to implement stochastic simulations;
- interpret biological data and predictions that simulations yield.

##### ***Coursework activity #2: Modelling DNA's mechanical response***

The mechanical properties of DNA and other biological filaments are important factors for cell functions. In this coursework you will simulate a DNA molecule using a bead-spring chain model undergoing thermal fluctuations, and compare your results with the theory and existing experimental data.

Learning objective:

- understand models and Brownian dynamics of biological polymer;
- code and carry out the simulations; statistically analyse the data;
- interpret the simulations output in comparison with theory and experimental data.

#### **4G2 Biosensors**

The coursework will be assessed on two marked assignments. The first assignment will involve a laboratory session illustrating the functional demonstration of glucose sensor technology. This assignment will be marked on individual reports handed in Monday 13 February. The second assignment will involve a laboratory session illustrating the principle of a quartz crystal microbalance and related acoustic sensor technologies. This assignment will be marked on individual reports to be handed in Wednesday 15 March.

#### **4G3 Computational Neuroscience**

For information on coursework, see the [course web page](#).

The course demonstrates how mathematical analysis and ideas from engineering-related disciplines (dynamical systems, signal processing, machine learning, optimal control, and probabilistic inference) can be applied to gain insight into the workings of the nervous system. The course highlights a number of real-world computational problems that need to be tackled by any 'intelligent' system, as well as the solutions that biology offers to some of these problems. The treatment is fairly mathematical and the [coursework](#) involves writing and running programs to gain hands-on experience with the subject.

#### **4G4 Biomimetics**

Students will work in groups of 2-3 on a biomimetics design portfolio for one specific case from any of the following: biomimetic materials (e.g. bone, shell); natural structures (e.g. photonic crystals, lotus paint, adhesives); robots that swim, fly, or crawl like creatures; or any other topic identified as acceptable via discussion with the module leader. The marking will be as follows:

20% on a group mid-term presentation of the selected project and literature review (occupying the final 2 lecture slots)

30% on an individual preliminary paper (4 pages) comparing a natural system to current engineering practice

50% on an individual design dossier - a detailed analysis of the selected biomimetic solution including quantitative comparisons and calculations, with optional prototypes or experiments.

### **Group M: Multidisciplinary modules**

#### **4M1 French**

The students will prepare 3 major pieces of coursework:

- Two written reports (30% each)

- Oral presentation (40%)
- The assignments will be marked for both language and content (50% language, 50% content)

#### **4M2 German**

The students will prepare 3 major pieces of coursework:

- Two written reports (30% each)
- Oral presentation (40%)
- The assignments will be marked for both language and content (50% language, 50% content)

#### **4M3 Spanish**

The students will prepare 3 major pieces of coursework:

Two written reports (30% each)

Oral presentation (40%)

The assignments will be marked for both language and content (50% language, 50% content)

#### **4M9 Surveying Field Course**

The Course runs continuously over a two week period, and includes the following:

- Exercise planning and siting of control stations;
- Fixing of control stations using GNSS;
- High-accuracy traversing and resectioning;
- Fixing of heights by precise digital levelling and trigonometric heighting;
- Long-range distance measurement;
- Three-dimensional setting out;
- Adjustment, computation and record keeping.

The output of this course will be a set of numerical calculations leading to the setting-out of one or more points in the field. Since incorrect answers will be systematically eliminated from this result, assessment will be based on the course demonstrators' estimation of each student's ability to:

- Take accurate readings efficiently with the equipment provided;
- Make a neat and decipherable record of other students' readings;
- Produce accurate and well laid-out calculations;
- Check the calculations of others;
- Plan and manage the activities of the team;
- Generally contribute to the efficiency and productivity of the team.

#### **4M14 Sustainable Development**

Students are expected to complete two pieces of coursework. The first coursework will involve a short piece of writing that will respond to a topic on the theme of engineering and

sustainable development. This will account for 20% of the total marks and will serve as practice for writing a longer assignment. The second coursework will require students to write an essay (maximum 2500 words), which will account for 80% of the total marks. There will be scope for students to choose a topic that interests them.

Students are expected to do additional research and investigation beyond the course content in order to complete the coursework assignments satisfactorily.

#### **4M17 Practical Optimization**

1. Investigation of a moderate size Linear Regression problem with various norm and regularization approximations (50%)
2. Investigation of the performance of two stochastic optimization methods on a hard problem (50%)

#### **4M19 Advanced Building Physics**

Students will undertake two tranches of coursework that are both aimed at assessing the performance of an indoor space in terms of energy efficiency and occupant comfort. The first coursework consists of numerical building performance simulations of specified rooms within CUED. The second coursework consist of field measurements within the specified rooms, where the students will use a range of instruments for characterising the environmental performance and comfort levels. The students will subsequently use the numerical and experimental data from their work to develop evidence-based proposals for improving the energy efficiency and comfort within the indoor space. All coursework will be submitted at the start of Lent Term.

- Report 1: Building performance simulation workshop (Practical exercises / simulations)
- Report 2: Performance assessment of real-world space based on field measurements.

#### **4M20 Robotics**

Each student will be assessed by the following three components of coursework:

30%: Individual report to a problem set. The problem set consists of theoretical questions about robot control as well as some hands-on exercise on robot simulation. Details will be instructed in the first lecture.

20%: Group presentation and robot competition. Students will work in a team of 2-4 people to develop and investigate their own manipulation/locomotion robots based on the kits provided. In the last week of the term, each team should give a 5-minute presentation and demonstrate the performance for competition. Details will be instructed in the first and second lectures.

50%: Individual dossier about the development and investigation of the projects. Each student should write a report about the project, and demonstrate how the theories and methods introduced in the lectures are used.

### **Group I: Imported modules**

#### **4I1 Strategic Valuation (TPE25)**

100% individual project combining spreadsheet modelling, written analysis and a management-style report.

The coursework consists of two parts: Task I (65%-70%) and Task II (30%-35%).

- Task I contains a number of subtasks, in which students are asked to conduct intensive Excel modelling, to answer questions, to provide analysis, and to give intuitive business interpretations.
- Task II is a short presentation and is assessed by a set of criteria: intuition (business implication), prioritising information (structure), clarity and use of visual aids such as charts and graphs, and language.

The coursework will be carried out during Michaelmas/Lent term break and will be submitted right before the beginning of the Lent term in January 2018.

#### **4I7 Electricity and Environment (TPE7)**

##### ***First piece of coursework [30/100]***

Use the UK 2050 calculator to generate own electricity related scenario.

##### Learning objectives:

- To develop an internally consistent quantified energy scenario for a real economy
- To get a sense of the scale of the difficulty of the energy transition challenges for electricity

##### ***Second piece of coursework [70/100]***

Essay on the 2030 decarbonisation challenge facing the UK electricity system.

##### Learning objectives:

- To discuss the challenge of decarbonising the UK electricity system by 2030.
- To cover both the economic and engineering challenges facing the UK electricity system.

#### **4I11 Advanced Fission and Fusion Systems**

1. Fast reactor transient analysis using provided computer models. This part of coursework will be preceded by an examples class, where these models will be introduced and demonstrated.

2. Group project (3-4 students) researching into a particular advanced reactor design. This part will be assessed by a group presentation to the rest of the class. The presentations will be scheduled at a convenient time outside the normal lectures schedule.

3. Problem set on advanced fission reactors, plasma physics and fusion technology.