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School *of* Engineering *and* Materials Science

H100: BSc(Eng) Engineering for 2010/11

Programme Description

This programme include the core units that are common to all the engineering degrees within the School of Engineering and Materials Science.
The key difference is the wider range of options on H100 and H106. Instead of the other units being confined to a single branch of engineering such as Aerospace Engineering, students can take a mixture of topics selected from the different branches of engineering.The H106 course is a BEng degree and requires students to take a 2 unit project in their third year. The H100 course is a BSc(Eng) degree and this gives students the additional flexibility of taking a 1 unit project, a 2 unit project or no project at all.

Career Opportunities

These programmes are best suited to students who want a broad engineering degree which they intend to build on with further studies such as an MBA or professional accountancy qualifications These degrees are also suitable for any field that requires graduates with good analytical or numerical skills.
For students who wish to enter an engineering design office the other more narrowly defined engineering degrees are more appropriate because their narrower focus enables a single branch of engineering to be studied to a greater depth.
For students who are uncertain about which field of engineering they wish to specialise in, entry on to either H100 or H106 can enable this choice to be left until the start of the second year of their degree where the flexibility of the courseunit system allows transfer onto one of the other more specialist engineering degrees.

Programme Structure

Year 1 Semester A:	DEN101 (4) Mechanics of Fluids 1	DEN102 (4) Stress Analysis	DEN121 (4) Mathematics for Engineers 1	DEN117 (4) Aspects of Medical Engineering 1 or DEN118 (4) Aspects of Aerospace Engineering Design or DEN119 (4) Aspects of Mechanical Engineering Design
Year 1 Semester B:	DEN107 (4) Thermodynamics 1	DEN108 (4) Dynamics	DEN122 (4) Mathematics for Engineers 2	DEN117 (4) Aspects of Medical Engineering 1 or DEN118 (4) Aspects of Aerospace Engineering Design or DEN119 (4) Aspects of Mechanical Engineering Design

Year 2 Semester A:	DEN109 (5) Electrical Technology	DEN240 (5) Mechanics of Fluids for Medical Engineers or DEN241 (5) Mechanics of Fluids for Mechanical Engineers or DEN242 (5) Mechanics of Fluids for Aerospace Engineers	DEN223 (5) Mathematics for Engineers 3	DEN218 (5) Graphic Communication, Materials and Manufacture or MAT306 (5) Functional Materials in Medical Engineering
Year 2 Semester B:	DEN201 (5) Structural Analysis	DEN202 (5) Engineering Design	DEN211 (5) Vibrations and Control of Dynamic Systems	DEN233 (5) Low Speed Aerodynamics or DEN208 (5) Heat Transfer or DEN214 (5) Aspects of Medical Engineering 2

Year 3 Semester A:	DEN318 (6) Individual Project	1 Option From Other Engineering Programmes	1 Option From Other Engineering Programmes	1 Option From Other Engineering Programmes
Year 3 Semester B:	DEN318 (6) Individual Project	MAT402 (5/6) Operational and Financial Management	1 Option From Other Engineering Programmes	1 Option From Other Engineering Programmes

Notes on Programme Structure

The numbers in brackets indicate the "Academic Level" of each module, where a typical first year module is delivered at a level 4, whilst a master's module is delivered at level 7.DEN318 can be substituted for:

DEN319 Project (1cu) plus 1 other option
No project plus 2 other options

Year 1 Modules

DEN101: Mechanics of Fluids 1

Fluid Dynamics is one of the underpinning sciences in Engineering. Most engineering process involve fluid flow, including flow over aircraft, through combustion engines or cardiovascular flow. In this module we work from first principles to describe the hydrostatic pressure variation, then move on to analyse moving flow using the mass conservation, energy conservation and momentum balance equations.

Reading List:
White, Frank M. *Fluid mechanics.* McGraw-Hill Higher Education. 2008
Munson, B.R., et al. *Fundamentals of fluid mechanics.* Hoboken, N.J. : Wiley. 2009

DEN102: Stress Analysis

This module introduces the fundamental principles of stress analysis for linearly-elastic materials and their application to simple structures.

Reading List:
Budynas, Richard G. *Advanced strength and applied stress analysis.* WCB/McGraw-Hill. 1999Mechanics of Engineering Materials by P P Benham, R J Crawford and C G Armstrong, 2nd Ed. Longman 1996.

Mechanics of Materials by J M Gere and S P Timoshenko, 3rd SI Ed. PWS-Kent Pub. Co. 1990.

Engineering Mechanics: Vol.1 Statics by J L Meriam and L G Kraige, 3rd Ed. Wiley, 1993.

DEN107: Thermodynamics 1

This module formally introduces the fundamental principles of general non-equilibrium thermodynamics; it examines applications of single-constituent fluids, and provides background for all applications in engineering.

Reading List:
E. P. Gyftopoulos and G. P. Beretta. *Thermodynamics: Foundations and Applications.* 2005

DEN108: Dynamics

This module provides an introduction to the modelling and analysis of mechanical systems. It includes analysis of the motion (i.e. kinematics) of particles and rigid bodies It then goes on to deal with the forces causing these motions (i.e. kinetics) by the application of Newton's laws of motion. The techniques developed are essential in the design and analysis of all engineering systems and hence this is an essential module for students of all engineering disciplines.

Reading List:
J L Meriam & L J Kraige. *Engineering Mechanics, Vol 2, Dynamics.* Wiley. 2003Optional Further Reading
Engineering Mechanics: Dynamics. R C Hibbeler. (7th Ed.) Prentice Hall, 1995.
Dynamics: Engineering Mechanics, Bedford and Fowler, Addison-Wesley, 1996.
Engineering Mechanics: Dynamics. W F Riley and L D Sturges, Wiley 1993.
Dynamics. C E Drabble. Macmillan, 1997.
Dynamics. (Work out series) C E Drabble. Macmillan.
Principles of Dynamics. J Grosjean.
Basic Mechanics with engineering applications. J N Fawcett & J S Burdess, Arnold, 1988.

DEN117: Aspects of Medical Engineering 1

This course provides an introduction to Medical Engineering, which is taught around the focused topic of the knee. In addition the course provides basic knowledge of associated core engineering topics such as computing, statistics and presentational skills, including communication through engineering drawing.

The course provides an understanding of basic anatomy and physiology associated with the knee along with study of key clinical problems. The course provides information on the way medical engineering is used to study, diagnose and treat the knee. This involves a basic study of relevant aspects of medical imaging, rehabilitation engineering, implant materials/design and tissue engineering as applied to the knee.

The course also aims to develop more generic engineering skills, including
investigative and communication skills through Problem Based Learning. Laboratory activities are used to develop the

ability to integrate the results of laboratory investigations with the theoretical background and have an understanding of basic statistical principles and methods.

Reading List:

Knee ligaments: structure, function, injury and repair. Eds. Daniel, Akeson & O'Connor, Raven Press, New York, 1990.

Biomechanical Basis of Orthotic Management. Eds Bowker, Condie, Bader, Pratt, Wallace.Butterworth-Heinemann, 1993.

Cell and Molecular Biology - concepts and experiments. G Karp, Wiley & Sons, 1996.

Gait Analysis, M. Whittle, 3rd Ed. Butterworth-Heinemann, 2001.

Glyn James, Modern Engineering Mathematics (4th Edition), Pearson, Harlow, 2009.

H.J.C. Huijberts, Statistics and Computing, Pearson, Harlow, 2010.

•PRINCIPALS OF ANATOMY AND PHYSIOLOGY-9th Edition.
Tortora and Grabowski
Chapters 1, 3, 4, 6, 8-11

•MOSBY'S CRASH COURSE IN THE MUSCULOSKELETAL SYSTEM
Biswas
Chapters 1-3

•SURGERY OF THE KNEE-2nd Edition
Insall
Volume 1, Chapters 1, pp 1-20

•ORTHOPAEDIC BASIC SCIENCE
Simon

•HOLLINGSHEADS TEXTBOOK OF ANATOMY-4th Edition
Rosse and Gaddum-Rosse
pp 35-42

CLINICALLY ORIENTED ANATOMY-4th Edition
Moore and Dalley
pp 617-621

•SURGERY OF THE KNEE-2nd Edition
Insall
Chapter 1

•THE PROBLEM KNEE
MacNicol

•THE KNEE-FORM FUNCTION AND LIGAMENT REPLACEMENT
Muller
pp 2-8

•PRINCIPALS OF ANATOMY AND PHYSIOLOGY-9th Edition.
Tortora and Grabowski
Chapters 3, 4, 6, 8-11

•MOSBY'S CRASH COURSE IN THE MUSCULOSKELETAL SYSTEM
Biswas
Chapter 3

•BASIC MEDICAL HISTOLOGY
Kessel
Chapters 1, 2 5-7

•ORTHOPAEDIC BASIC SCIENCE
Simon

•STRUCTURAL BIOLOGICAL MATERIALS
Elices
Chapters 4 & 6

•KNEE MENISCI Basic and Clinical Foundations
Mow, Arnoczky & Jackson
Chapters 1-4

•HUMAN PHYSIOLOGY The Basis of Medicine
Pocock & Richards
Chapters 2-5

•INTRODUCTION TO BIOMEDICAL ENGINEERING
Enderle, Blanchard & Bronzino
Chapter 2

SCIENCES BASIC TO ORTHOPAEDICS
Hughes & McCarthy
Chapters 1-5

PRINCIPLES OF CELL AND MOLECULAR BIOLOGY
Kleinsmith & Kish.
Chapter 1

BASIC BIOMECHANICS OF THE MUSCULOSKELETAL SYSTEM
Nordin and Grabowski

THE KNEE-FORM FUNCTION AND LIGAMENT REPLACEMENT
Muller
pp 1-75

SURGERY OF THE KNEE-2nd Edition
Insall
Volume 1, Chapter 3, pp 43-62

ORTHOPAEDIC BASIC SCIENCE
Simon

INTRODUCTION TO BIOMEDICAL ENGINEERING
Enderle, Blanchard & Bronzino
Chapter 9

SCIENCES BASIC TO ORTHOPAEDICS
Hughes & McCarthy
Chapters 14, 15,19

FUNDAMENTALS OF ORTHOPAEDIC BIOMECHANICS
Burstein & Wright.
Chapter 1-3

ENGINEERING MATERIALS
Ashby & Jones
Chapter 3

•BIOMATERIALS, MEDICAL DEVICES AND TISSUE ENGINEERING
Silver
Chapters 1, 4 and 9

•ORTHOPAEDIC BASIC SCIENCE
Simon

•SCIENCES BASIC TO ORTHOPAEDICS
Hughes & McCarthy
Chapters 18

•INTRODUCTION TO BIOMEDICAL ENGINEERING
Enderle, Blanchard & Bronzino
Chapter 11

•INTRODUCTION TO BIOENGINEERING
Berger, Goldsmith, Lewis
Chapters 8 and 9

•TOTAL KNEE ARTHROPLASTY
Rand

•SURGERY OF THE KNEE
Insall
Volume 2

DEN118: Aspects of Aerospace Engineering Design

This module provides an introduction to Aerospace Engineering in the subjects of aerodynamics, propulsion, flight mechanics and integrated platforms. The generic engineering topics of computing, statistics and technical drawing are also taught in a fundamental level. The course is given in a series of lectures, some jointly with the other first year engineering aspects courses (DEN117, DEN119) and by following two Problem Based Learning (PBL) exercises formulated for aerospace studies.

Reading List:
Anderson J D. *Introduction to Flight.* McGraw-Hill, Boston,. 2000.Kermode A C ., Flight without formulae, Longman, 1989

Kermode A C ., Mechanics of Flight, Eds. Barnard R.H. and Philpott, Longman, 1996

Glyn James, Modern Engineering Mathematics (4th Edition), Pearson, Harlow, 2009.

DEN119: Aspects of Mechanical Engineering Design

This module provides an introduction to Mechanical and Energy Engineering. It aims to motivate students to study engineering and to pursue it as a career by setting the courses they will study over the next 3/4 years into the broader context of mechanical engineering and in particular to energy engineering. It also aims to teach some fundamental skills necessary for engineers including computing, statistics and presentational skills.

Reading List:
E V Krick. *An Introduction to Engineering and Engineering Design.* John Wiley & Sons. 1969
Neil Phelps and Colin Simmons. *Engineering drawing practice - A guide for higher education to BS8888:2006.* BSI. 2007
Alf Yatwood. *Introduction to AutoCAD 2008.* Newnes. 2007Ullman, P, The Mechanical Design Process, 2nd Edition, McGraw Hill

Pahl, G and Beitz, W, Engineering Design, 2nd Edition, Springer-Verlag.

Central Electricity Generating Board, Modern Power Station Practice.

Stone, R, Introduction to Internal Combustion Engines, Macmillan.

Glyn James, Modern Engineering Mathematics (4th Edition), Pearson, Harlow, 2009.

DEN121: Mathematics for Engineers 1

This course takes the engineering student to post 'A' Level standard in some topics and provides the mathematical skills appropriate to the courses for which it is a pre-requisite. Topics covered are numbers, algebra and geometry, functions, differentiation, integration and basic vector algebra.

Reading List:

Glyn James. *Modern Engineering Mathematics.* Pearson. 2008G James - Modern Engineering Mathematics 4th Edition (2008) Pearson, Harlow.
A Croft and R Davidson - Mathematics for Engineers 3rd Edition (2008) Pearson, Harlow.

DEN122: Mathematics for Engineers 2

This course provides further development of technical mathematics, which both consolidates the syllabus of Mathematics for Engineers 1 and is a pre-requisite for advanced engineering courses. Topics covered are complex numbers, matrix algebra and further calculus.

Reading List:
Glyn James. *Modern Engineering Mathematics.* Pearson. 2008A Croft and R Davidson - Mathematics for Engineers 3rd Edition (2008) Pearson, Harlow.

Year 2 Modules

DEN109: Electrical Technology

The course provides some fundamental knowledge of DC and AC circuits, operational amplifiers, and semiconductors technology. It also includes the concept and application of filtering, analogue and digital signal and conversion and computer based data acquisition. This knowledge enables an introduction to sensing physical parameters, signal conditioning and signal transmission. It gives an introduction to the generation and conversion of electrical power and the application of electrical technology in the three areas of Aerospace, Mechanical Engineering and Medical Engineering.

Reading List:
Hughes Electrical Technology. I McKenzie Smith, Pub. Pearson

Introductory Linear Electrical Circuits & Electronics. Kelley. Pub. Wiley

Linear Circuit Analysis. DeCarlo & Lin. Pub. Oxford (Good examples)

Introduction to Electric Circuits. Dorf and Svoboda, Pub. Wiley

The Art of Electronics. Horowitz and Hill, Pub. Cambridge University

Electronic devices and circuitry, Boylestad & Nashelsky, Pub. Pren. Hall

Digital Systems, Tocci, Widmer and Moss, Prentice Hall.

DEN201: Structural Analysis

This course derives concepts for structural analysis and is based on the content of stress analysis (DEN102). Analytical methods for one-dimensional (e.g. statically indeterminate beam theory, stability, asymmetric bending, virtual work) and multi-dimensional modelling (Mohr's circle, principle stresses and strains) are discussed and experimental aspects (buckling, asymmetric bending) are included. Particular focus are the energy methods as a fundamental theory for computational methods taught in the third year (DEN331).

Reading List:
Russell C. Hibbeler. *Mechanics of Materials.* Prentice Hall. 2005

DEN202: Engineering Design

An introduction to the process of engineering design, primarily assessed by a group project in which students design, manufacture, test and then display their own prototype product (100% coursework).

Reading List:
Recommended Reading
Dorrington, G & Kirk, G, Engineering Design Supporting Notes, available from School office

Matthews, C. Engineering Data Book, Wiley, 3rd edition, 2009.

Additional/Supplementary Reading
Hurst, K., “Engineering Design Principles”, Arnold 1999.
French, M.J., “Conceptual Design for Engineers”, The Design Council and Springer Verlag, 1985
Pahl, G., and Beitz W., “Engineering Design”, The Design Council and Springer Verlag, 1984
Ullman, D.G., “The Mechanical Design Process”, McGraw Hill International, 1992
Yarwood A., “Introduction to AutoCAD Release 13”, T 385 “Engineering Drawing Practice For Schools and Colleges”, PP 7308, 1986
“BS 308 Engineering Drawing Practice” British Standard 308, Part 1, 1993

Additional/Supplementary Videos and Software
“Design: Principles and Practice: Introduction to Design, Symmetry, Drawing for Engineers, Creativity and Conceptual Design, Consumer Products, Design for Manufacture” TA174 DES “Profit by Design”, ESDU, T51 ESD
“Design Builder,” available on the Novelle network: Windows 95 or 3.1, 3 Departments

Additional/Supplementary Journals

"Design Engineering," TA
"Design," The Journal of the Design Council, TA

DEN208: Heat Transfer

The course aims to provide students with the fundamental principles of heat transfer and professional skills to analyse heat transfer problems. Topics include conduction, single-phase forced and free convection, condensation, boiling, radiation and simple engineering applications.

Reading List:
William S Janna. *Engineering Heat Transfer.* CRC Press. 2009
F P Incropera and D P DeWitt. *Fundamentals of Heat and Mass Transfer.* Wiley. 1996
J P Holman. *Heat Transfer.* McGraw-Hill. 1996
Frank Kreith & Mark S Bohn. *Principles of Heat Transfer.* West Publ.Co.,. 1993Jh Lienhard IV and JH Lienhard V, a free heat transfer textbook
http://web.mit.edu/lienhard/www/ahtt.html

DEN211: Vibrations and Control of Dynamic Systems

The course includes modelling of dynamic systems, the study of vibrations of one-degree-of-freedom dynamic systems, applications of control theory and control systems components to the synthesis of regulators and servomechanisms, and to introduce the students to Computer Aided Control Systems Design using MATLAB.

Reading List:
Kelly, S.G. (2000). Fundamentals of Mechanical Vibrations. 2nd. MrGraw Hill. / ISBN:0071163255

DEN214: Aspects of Medical Engineering 2

The module provides material in the development of the themes running through the Medical Engineering programme. It provides relevant applications for the core engineering subjects, whilst introducing new and innovative concepts, based around the focused topic of the spine in health, trauma and congenital disease. In particular, it describes medical engineering solutions to support the functional requirements of subjects with spinal conditions, particularly those who become wheelchair-bound.

Reading List:
Clinical biomechanics of the Spine. Eds. White & Panjabi, Lippincroft, 1990
Biomechanical Basis of Orthotic Management. Eds Bowker, Condie, Bader, Pratt, Wallace. Butterworth-Heinemann, 1993
Handbook of Clinical Neurology: Spinal Cord Trauma. Ed. Frankel, Elsevier, 1992

DEN218: Graphic Communication, Materials and Manufacture

This module prepares students for the subsequent module DEN202 Engineering Design. It includes the basic knowledge needed to communicate the design in a set of properly prepared engineering drawings, as well as make a preliminary assessment of the most appropriate materials and manufacturing methods.

Reading List:
Neil Phelps and Colin Simmons. *Engineering drawing practice - A guide for higher education to BS8888:2006..* BSI. 2007
James Newell. *Essentials of Modern Materials Science and Engineering.* John Wiley & sons. 2009
Alf Yatwood. *Introduction to AutoCAD 2008.* Newnes. 2007
Colin H. Simmons and Dennis E. Maguire. *Manual of Engineering Drawing to British and International Standards.* Newnes. 2004Engineering Design, G Pahl and W Beitz, 2nd edition, Springer Verlag, 1996.
Engineering Drawing with CAD Applications, O Ostrowsky, Butterworth-Heinemann, 1989. (reprinted 2002).
Mechanical EngineeringDesign, 7th Ed, J E Shigley, C R Mischke and R G Budynas, McGraw Hill, 2003.

DEN223: Mathematics for Engineers 3

The course provides further development of technical mathematics and (symbolic) computing using MATLAB, which both consolidates the syllabus of Mathematics for Engineers 2 and is a pre-requisite for advanced engineering courses. Topics covered are differential equations, Laplace transforms, Fourier series, and computing and numerical methods.

Reading List:
Glyn James. *Modern Engineering Mathematics.* Pearson. 2008Anthony Croft and Robert Davison,

"Mathematics for engineers: a modern interactive approach (2nd Ed)", Pearson, Harlow, 2004. TA330 CRO.

Further, (almost) any book under TA330 in the library.

DEN233: Low Speed Aerodynamics

The course builds on the concepts introduced in Mechanics of Fluids I to study inviscid, incompressible flow over aircraft wings. The concepts of stream function, velocity potential, vorticity and circulation are developed and exact solutions of flow over some simple two-dimensional bodies are discussed. From this basis, methods are developed for calculating forces and moments on thin wing sections and finite-span wings in low-speed flow.

Reading List:
J D Anderson. *Fundamentals of Aerodynamics.* McGraw Hill. 2006

DEN240: Mechanics of Fluids for Medical Engineers

This module covers fundamentals on fluid dynamics, including steady laminar flow in a pipe and a network of pipes, boundary layer theory and frictional drag forces on an object. Students will study the non-Newtonian properties of the blood and appreciate its importance in physiological flows.

Reading List:
Frank M.White. *Fluid Mechanics.*
F.Motallebi. *Lecture Notes.*

DEN241: Mechanics of Fluids for Mechanical Engineers

This module covers fundamentals on fluid dynamics, including steady laminar flow in a pipe and a network of pipes, boundary layer theory and frictional drag forces on an object. Students will develop knowledge on pumps and turbine characteristics and study their performance in pipeline systems.

Reading List:
Frank M.White. *Fluid Mechanics.*
F.Motallebi. *Lecture notes.*

DEN242: Mechanics of Fluids for Aerospace Engineers

This module covers fundamentals on fluid dynamics, including steady laminar flow in a pipe and a network of pipes, boundary layer theory and frictional drag forces on an object. Students will develop knowledge on compressible aerodynamics, for example isentropic flows in variable area ducts and flow properties through normal shock waves.

Reading List:
F.Motallebi. *Lecture Notes.*
White, Frank M. *Mechanics of Fluids.* Mc Graw Hill.

MAT306: Functional Materials in Medical Engineering

This course covers the concept and applications of synthetic materials for use in the body, based on a knowledge of the natural materials found in the body. Topics included in the course cover the structure of materials, metals, ceramics and polymers applied in medicine. It describes a range of material properties, biomaterial evaluation, biocompatibility. The structure-function relationship of hard and soft tissues, including bone, articular cartilage, tendon/ligaments and blood vessels are discussed.

Reading List:
Ratner, B. D. *Biomaterials science : an introduction to materials in medicine.* Elsevier Academic Press. 2004
Ashby and Jones. *Engineering materials. 1, An introduction to their properties and applications.* Pergamon Press.
Callister. *Materials Science and Engineering an introduction.* Wiley.

Year 3 Modules

DEN318: Individual Project

The purpose of the project is to provide an in depth knowledge of a particular area of Engineering. The project may typically involve experimentation or computational modelling which will be carried out in an subject area developed together with an academic member of staff (the supervisor). Emphasis will be placed on the analysis, interpretation and discussion of the results or data obtained.

Reading List:
Third Year Project Handbook - Guidelines for students

MAT402: Operational and Financial Management

This is an important subject for everyone who will be working in organisations, especially those who will have the responsibility of managing other staff, managing projects and contributing to the design of operating systems. The topics we study include different types of organisations and their environment, models and tools for managing operations, financial management and the marketing of goods and services.

Reading List:
Boddy, D. *Management: An Introduction.* Prentice Hall. 2005
Slack, N., Chambers, S. and Johnston, R. *Operations Management.* Prentice Hall. 2005
Russell and Taylor. *Operations Management.* Prentice Hall. 2003The following websites are useful sources of information:
http://www.mhhe.com
http://www.iomnet.org.uk
www.mcb.co.uk
www.businessweek.com
www.economist.co.uk
www.ft.com
www.bized.ac.uk
www.dti.gov.uk