London South Bank University

# Engineering Design, Analysis and Manufacture

EEB_7_307

School of Engineering

Level 7

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# 1. MODULE DETAILS

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|---|---|
| **Module Title:** | Design, Analysis and Manufacture |
| **Module Level:** | 7 |
| **Module Reference Number:** | EEB_7_307 |
| **Credit Value:** | 20 |
| **Student Study Hours:** | 200 |
| **Contact Hours:** | 39 |
| **Private Study Hours:** | 161 |
| **Pre-requisite Learning (If applicable):** | BEng Solid Mechanics and FEA; |
| **Co-requisite Modules (If applicable):** | |
| **Course(s):** | MSc Mechanical Engineering; MEng Mechanical Engineering |
| **Year and Semester** | 2019/20 Semester 1 |
| **Module Coordinator:** | Ben Lishman |
| **MC Contact Details (Tel, Email, Room)** | ben.lishman@lsbu.ac.uk<br>0207 815 7532<br>Room T404 |
| **Teaching Team & Contact Details (If applicable):** | Barney Townsend<br>0207 815 7633<br>barney.townsend@lsbu.ac.uk<br>Room T711 |
| **Subject Area:** | Mechanical Engineering |
| **Summary of Assessment Method:** | 100% Coursework |

# 2. SHORT DESCRIPTION

This module broadens the student's knowledge base. It will involve case studies and practical work that demonstrate how advanced analysis is employed in the engineering design process. The module will involve the application of Finite Element Analysis, and CAD-CAM, with an integrated approach to engineering design. It will develop a critical awareness of current problems and solutions strategies, whilst building the practical abilities of students to apply the knowledge and understanding to real problems, exploring solutions through digital and physical prototypes. It will be 100% coursework assessed. It will enhance employability by providing students with demonstrable evidence of practice based analysis work in the field of engineering design.

# 3. AIMS OF THE MODULE

The aim of this module is to develop students' knowledge and understanding of a range of Engineering Design principles and techniques in relation to mechanical engineering systems, and the use of Finite Element Analysis, software and analytical techniques in the design and evaluation of mechanical components. Students will apply appropriate theoretical and practical methods to the analysis and solution of engineering design problems. They will learn how to prototype and implement their proposed solutions using appropriate manufacturing technologies.

# 4. LEARNING OUTCOMES

## 4.1 Science and Mathematics

1. Understanding of the concepts and limitations of industrial manufacturing, and the ability to evaluate them critically and to apply them effectively in engineering projects. (SM3m)

## 4.2 Engineering Analysis

2. Ability both to apply appropriate engineering analysis methods for solving complex problems in engineering and to assess their limitations. (EA1m)

3. Ability to collect and analyse research data and to use appropriate engineering analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, and use engineering analytical methods. (EA3m)

## 4.3 Design

4. Knowledge, understanding and skills to work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies (D1m)

5. Knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations and to generate an innovative design for products, systems, components or processes to fulfil new needs. (D2m) (D3m)

## 4.4 Engineering Practice

6. Ability to apply design engineering techniques, taking into account industrial constraints of manufacturing and prototyping limitations (EP3m)

# 5. ASSESSMENT OF THE MODULE

The module will be 100% coursework assessed through a single summative assignment through which all learning outcomes will be assessed.

In order to pass the module, students must attain an overall aggregated mark of at least 50%. The learning content of this module is highly practical and applied, and as such the learning outcomes will be assessed through coursework. Assignments may include the use of software workshops and laboratories. The typical word equivalence for written reports will be a maximum of 4000 words per assignment.

Assignments will be assessed according to the following general guide. More details regarding the marking scheme will be distributed with individual assignments.

| Grade | Mark | Description |
|---|---|---|
| A | Over 70 | Excellent work all round. |
| B | 60 – 70 | Good work: or a mixture of excellent plus average work. |
| C | 50 – 60 | Average work: or a mixture of good and below average. |
| D | 40 – 50 | Below average overall but still acceptable.<br>40 may be given for acceptable work that is received up to 2 weeks late. |
| E | 35 - 40 | Marginally unacceptable. May well be recovered by good performance on another assignment. |

| | | |
|---|---|---|
| F | Below 35 | A poor performance and not really likely to be compensated by good performance on another assignment. |
| X | 0 | No attempt at the assignment, or work received more than 2 weeks late. |

**Late submissions**
Students are expected to submit the assignments on dates specified within the project brief. A late submission form should be filled in if you are unable to hand your work by the deadline.

The Academic Regulations allow you to hand your work in up to two weeks after the deadline. However, your mark will be capped to 50. After two weeks the work will be marked zero. A student who is unable to submit the work within the deadline must inform the Module leader and Course/Programme Director of the non-submission as s/he may then make a claim for extenuating circumstances.

# 6. FEEDBACK

Students will receive ongoing formative verbal feedback throughout the course of the module through tutorials in classes. Summative feedback on assignments will normally be given no later than 15 days after the submission of the assignment.

# 7. INTRODUCTION TO STUDYING THE MODULE

## 7.1 Overview of the Main Content

- Systematic design and creative methods
- Concept generation techniques
- Concept testing and evaluation
- Prototyping / manufacturing methods and appropriate use of CAD/CAM
- Finite Element Analysis:
    - Basic concepts and types of FEA
    - Selection of appropriate modelling approaches
    - Control of errors
    - Mesh creation and the modelling techniques
    - Different types of analysis
    - Design optimisation
    - Relationships between CAD and FEA software
    - Implementation of FEA
- Case studies

## 7.2 Overview of Types of Classes

The teaching programme will be delivered during semester 1, and will take place in both design studios and computer labs. A series of lectures will introduce the key principles and techniques, and these will be supported by practical hand-on application of the techniques through exercises and coursework assignments. Students will have personal tutorials and interviews to assist them in the process, and interim assessments may take place to check progress and provide feedback.

You are expected to apply the design process with rigour and professionalism, to attend all sessions and participate fully in seminars and presentations. You are also expected to liaise with and consult teaching staff throughout the course.

**Attendance**

Attendance is compulsory and students will be penalised for lateness and/or failure to present and submit work. Please make sure you check LSBU Student Attendance monitoring at: http://www.lsbu.ac.uk/sdu/5min/samstud/

### 7.3 Importance of Student Self-Managed Learning Time

A significant proportion of your learning on this module will come from private study. If you do not spend the time putting in this sort of work it is unlikely that you will develop your skills to be able to achieve the learning outcomes, which are pre-requisite to much of the further work you will undertake on this course.

### 7.4 Employability

This module will provide students with a sound knowledge of the principles of Engineering Design commonly used in industry. It will help students to work in the relevant fields of Engineering, through building their portfolio of practice based projects, which are related to real-world examples through case studies.

## 8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

The module is comprised of lectures, demonstrations, and tutorials. Content and case studies will be introduced in lectures but students will be expected to explore, develop, and apply their knowledge through project based learning.

In project work, students will follow a given design brief, and will be expected to demonstrate creativity and innovative thinking in their approach to it. They will generate a range of potential solutions, and test and evaluate these through the use of virtual modeling, finite element analysis, physical prototyping and empirical testing techniques. They will use valid concept selection methodologies, taking into account relevant trade-offs, stakeholder needs, environmental considerations and Design for Manufacture, to propose a robust solution that is validated by their research throughout the project.

Students are expected to work in groups and independently, to articulate and synthesise their knowledge and understanding by applying intellectual and practical skills in effective ways in the contexts of Engineering Design Theory and Practice.

## 9. STUDENT EVALUATION

Previous masters students have expressed enthusiasm for the format of this module. Students will be asked to complete a Module Evaluation Questionnaire (MEQ) at some point during the module and the feedback will be considered during the remaining sessions of the module.

## 10. LEARNING RESOURCES

The Learning Resources Centre (LRC) “3 North” room (third floor, north side) is dedicated to the Faculty and you will find all the word-processing, 3D and 2D design software, rendering programmes, desktop publishing and photo-editing facilities that you need for your self-managed study available here, in addition to a number of large format printers. The building is open access from 8am to midnight during term time.

Workshop facilities for prototyping are also available in the basement workshops in Borough Road on an open access basis between 9am and 5pm (closed for lunch 1pm-2pm).

LSBU library provides and extensive resource of literature both in hard copy and through online resources, journals etc, and students are advised to familiarise themselves with it as soon as possible.

## 10.1 Core Materials

Bryden D. (2014) *CAD and rapid prototyping for product design*. Vol. Portfolio skills. Product design. London: Laurence King Publishing.

Cross N. (2008) *Engineering design methods: strategies for product design*. Chichester, England: J. Wiley. Available from:http://catdir.loc.gov/catdir/enhancements/fy0810/2008002727-d.html

Kurowski P. M. (2004) *Finite element analysis for design engineers*. Warrendale, PA: SAE International.

Milton A. and Rodgers P. (2013) *Research methods for product design*. Vol. Portfolio skills. Product design. London: Laurence King Pub.

Ulrich K. T. and Eppinger S. D. (2012) *Product design and development*. New York: McGraw-Hill.

## 10.2 Optional Materials

Ashby M. F. and Johnson K. (2010) *Materials and design: the art and science of material selection in product design*. Oxford: Butterworth-Heinemann. Available from: http://0-www.myilibrary.com.lispac.lsbu.ac.uk?id=261856

Baxter M. R. (2002) *Product design: a practical guide to systematic methods of new product development*. Cheltenham: Nelson Thornes.

Beisert F. T., Alias (Firm) (2005) *Learning design with Alias StudioTools: a hands-on guide to modeling and visualization in 3D*. Vol. Learning tools. [Toronto, Ont.]: Alias.

Daniel Schodek, Martin Bechthold, James Kimo Griggs, Kenneth Kao, and Marco Steinberg [no date] *Digital Design and Manufacturing*. Wiley.

De Bono E. (1977) *Lateral thinking: a textbook of creativity*. Vol. Pelican books. Harmondsworth: Penguin.

Hallgrimsson B. (2012) *Prototyping and modelmaking for product design*. Vol. Portfolio skills. London: Laurence King.

Lefteri C. (2006) *Materials for inspirational design*. Mies, Switzerland: RotoVision SA.

Lefteri C. (2008) *The plastics handbook*. Crans-Près-Céligny: RotoVision.

Mikell P. Groover [no date] *Principles of Modern Manufacturing*. John Wiley & Sons; 5th Edition SI Version edition (5 Feb 2013).

Thompson R. (2007) *Manufacturing processes for design professionals*. London: Thames & Hudson.

Waguespack C. (2011) *Mastering Autodesk Inventor 2012 and Autodesk Inventor LT 2012*. Indianapolis, Ind: Wiley Pub. Available from: http://0-www.myilibrary.com.lispac.lsbu.ac.uk?id=317729

## 10.3 Online Resources

*3D made easy* [no date]. 3D made easy ltd. Available from: http://www.3dmadeeasy.com/login

CADCIM Technologies [no date]. Available from: http://www.cadcim.com/

CADinfo.net - CAD CAM CAE Design Information Network [no date]. Available from: http://www.cadinfo.net/

CADuser.com - The CAD user magazine website for the uk [no date]. Available from: http://www.caduser.com/

Core77 / industrial design magazine [no date]. Available from: http://www.core77.com/

DEVELOP3D - Technology for the product lifecycle [no date]. Available from: http://www.develop3d.com/

Designboom magazine. Available from: http://www.designboom.com/

Free Student Software Downloads | Autodesk Education Community [no date]. Available from: http://www.autodesk.com/education/free-software/all

Design Council. Available from: http://www.designcouncil.org.uk/

Online magazines:

- http://www.core77.com/ - Core 77
- http://www.designboom.com/eng/ - Design Boom
- http://www.caduser.com/ - Caduser online
- http://www.develop3d.com – Develop 3d

## 10.4 Notes

**EXHIBITIONS / PLACES OF INTEREST:**
A core objective of this module is enhance your understanding of design. London hosts a wealth of resources and it is recommended that you visit a few of them for inspiration and to broaden your knowledge of design, art and other creative activities. Here are some ideas…..

**Geffrye Museum**
Kingsland Rd E2 http://www.geffrye-museum.org.uk/
Great history of English interiors in a terrace of almshouses in Shoreditch – nice café and herb garden
**Victoria and Albert Museum,**
Cromwell Rd SW7 http://www.vam.ac.uk/
**Museum of brands, packaging and advertising** 2 Colville Mews Lonsdale Rd W11
www.museumofbrands.com 10 – 6 Tues – Sat; student entry- £3.50;
**Science Museum**
Exhibition Rd SW7 http://www.sciencemuseum.org.uk/
**Design Museum ,** Shad Thames SE1
http://www.designmuseum.org/
***You can get free entrance to the Museum at any time if you borrow a ticket from the Information Desk (ground floor) in the Library***
**Natural History Museum,** Cromwell Rd SW7
http://www.nhm.ac.uk/
**Tate Modern ,** Bankside SE1 http://www.tate.org.uk/modern/information/
***You can get free entrance to the special exhibitions at any time if you borrow a ticket from the Information Desk (ground floor) in the Library***
**Tate Britain,** Millbank SW1 http://www.tate.org.uk/britain/
**National Gallery ,** Trafalgar Square WC1
http://www.nationalgallery.org.uk/
**National Portrait Gallery,** St Martins Lane WC1
http://www.npg.org.uk/live/index.asp
**Hayward Gallery,** South Bank Centre SE1
http://www.hayward.org.uk/ Not free!
**Barbican Centre** https://www.barbican.org.uk/
**Whitechapel Gallery** http://www.whitechapel.org Whitechapel High Street – next to Aldgate tube – free
**John Soane Museum** http://www.soane.org/
13 Lincoln's Inn Fields, London, WC2A 3BP
Tuesday to Saturday, 10-5pm. Free – an extraordinary house and private collection of artefacts
**National Maritime Museum, Greenwich observatory and the Queens House** Greenwich SE10
http://www.nmm.ac.uk/
**Wallace Collection** Manchester Square, W1U 3BN Free 10 – 5
http://www.wallacecollection.org/
**Kew Bridge Steam Museum** Green Dragon Lane Brentford
http://www.kbsm.org/
10 – 5 £8.50 with student ID – check web for details about weekend opening and running engines
**Horniman Museum**
http://www.horniman.ac.uk/ 100 London Road, Forest Hill SE23 FREE 10.30 – 5.30
Art Nouveau museum – private collection of ethnographic / tribal artefacts, natural history and musical instruments