London South Bank University

Module Guide

Thermofluids and Turbomachinery

ENG_6_452

School of Engineering

Academic Year 2018-19

Level-6

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1. UNIT DETAILS

Unit Title:	Thermofluids and Turbomachinery
Unit Level:	Level6
Unit Reference Number:	ENG_6_452
Credit Value:	20
Student Study Hours:	Contact hours: 65, Student managed learning hours: 135
Pre-requisite Learning (If applicable):	Thermofluids L4, Thermofluids and Sustainable Energy L5
Co-requisite Units (If applicable):	None
Course(s):	BEng(Hons), MEng (Hons) Mechanical Engineering
Year and Semester	2018-19, Semester 2
Unit Coordinator:	Mr.Ravee Sundararajan
MC Contact Details (Tel, Email, Room)	7108, r.sundar@lsbu.ac.uk T702
Teaching Team & Contact Details (If applicable):	
Subject Area:	Mechanical Engineering and Design
Summary of Assessment Method:	70% written examination, 30% coursework
External Examiner appointed for module:	

2. SHORT DESCRIPTION

This module provides a third study of heat transfer, fluid mechanics and thermodynamics exploring in-depth internal combustion engines, fluid-mechanics governing equations, performance of various types of pumps and turbines, and application of heat transfer to extended surfaces and heat exchangers.

3. AIMS OF THE UNIT

- To increase the student's understanding of thermodynamics through study of internal combustion engines.
- To increase the student's understanding of heat and mass transfer through study of heat exchangers, boiling, condensation and extended surfaces.
- To increase the student's understanding of fluid mechanics through study of the Navier Stokes equation, Euler's equation, and rotodynamic machines- e.g. pumps, fans and turbines.
- To improve the student's analytical skills.

4. LEARNING OUTCOMES

At the end of the module, students will be able to undertake the actions described in each of the four areas below.

At the end of the module, students will be able to undertake the actions described in each of the six areas below.

Knowledge and Understanding

- Derive the heat equation for an extended surface (fins), and solve to find the temperature distribution and heat transfer for a range of boundary conditions. **(SM1b, SM2b, EA1b, EA3b, EA4b,G1)**

- Analyse and solve problems associated with internal combustion engines, such as performance characteristics, combustion systems and the gas-exchange process. **(EA1b, EA3b, SM3b,G1)**
- Analyse and solve problems associated with turbomachinery (compressors, turbines and fans), such as performance characteristics and Eulers pump and turbine equation. **(EA1b, EA2b, EA3b, SM3b,G1)**
- Analyse the performance of heat transfer equipment such as heat exchangers, condensers, evaporators. **(EA1b, EA3b, SM3b,G1)**

Intellectual Skills

- Differentiate between the analytical approaches to compressible and incompressible flows and the role of the Navier Stokes equations in investigating the relationships between parameters in such flows. **(SM1b, SM2b, EA1b, EA3b, EA4b,G1)**

Practical Skills

- Investigate through experiment and analyse the performance of a power-producing device, such as an internal combustion engine. Analysis and data evaluation, use of published literature for comparison to experimental test data. **(P3, P4, P8, D6,G1)**

5. ASSESSMENT OF THE UNIT

This unit is assessed as follows:
- Examination: 70%
- Assignment: 30%

6. FEEDBACK

Feedback will normally be given to students 15 working days after the submission of an assignment.

7. INTRODUCTION TO STUDYING THE UNIT

7.1 Overview of the Main Content

This unit will further develop student's understanding of thermodynamics, fluid mechanics and heat and mass transfer by covering topics such as internal combustion engines, heat exchangers and turbomachinery

7.2 Overview of Types of Classes

Formal lectures, tutorials and demonstrations supported by handouts tutorial sheets and a dedicated module site on Blackboard for additional materials. Audio visual aids, case studies, group discussion seminars and the use laboratory experiments

7.3 Importance of Student Self-Managed Learning Time

The successful passing of this unit is very much dependent on the student dedicating considerable private study time. For this unit, this involves the student attempting all the tutorial sheets. Thermofluids and Turbomachinery cannot be studied at the last minute; the effort has to be continuous and steady throughout the semester.

7.4 Employability

Fluid mechanics, thermodynamics and heat/mass transfer are fundamental parts of a mechanical engineering degree and this unit introduces the material which will prepare students for further post-graduate study as well as for industry.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Week No	Date	Lecture	Lecture/Tutorial
1	01/02/2019	IC Engine -Air Standard Cycles, Revision	Tutorial
2	08/02/2019	IC Engine - Performance Characteristics	Tutorial (IMechE - talk)
3	15/02/2019	IC Engine - Gas Exchange Process	Tutorial
4	22/02/2019	IC Engine - Combustion System (Pt1)	Guest Lecturing (Kelvion Heat Exchangers)
5	01/03/2019	Assignment & Engine Test	
6	08/03/2019	Fluids: Continuity and Momentum Equation, 1D/3D CFD	Tutorial
7	15/03/2019	Introduction to CFD Software	Tutorial
8	22/03/2019	Fluids: Stress Tensors, Navier Stokes Equation	Tutorial
9	29/03/2019	Rotodynamic Machines - Eulers Pump 7 Turbine Eq, Pelton Wheel	Tutorial
10	05/04/2019	Rotodynamic Machines - Eulers Pump 7 Turbine Eq, Pelton Wheel	Tutorial
11	12/04/2019	Easter	
12	19/04/2019	Easter	
13	26/04/2019	Easter	
14	03/05/2019	Heat Transfer - Extended Surfaces	Tutorial
15	10/05/2019	Heat Transfer - Heat Exchanger, Condenser & Evaporator	Tutorial
18	17/05/2019	Revision	
19	08/06/2019	Exam (07/06/19)	

Programme of teaching subject to change - content & dates.

9. STUDENT EVALUATION

Please see the MEQ responses in a separate file

10. LEARNING RESOURCES

10.1 Core Materials

- Stone, R, Introduction to Internal Combustion Engines, 3rd Ed, Macmillan, 1999.
- Incropera, F. P. and De Witt, Fundamentals of Heat and Mass Transfer, 6th ed., 2007, Wiley.
- Douglas, Gasorek, Swaffield ``Fluid Mechanics'' 4th Ed Prentice 2000
- Rogers, G. and Mayhew, Y. Thermodynamics and Transport Properties of Fluids, 5th ed. Blackwell, 1995. (steam-tables)

10.2 Optional Materials

- Dixon S.L., Fluid Mechanics and Thermodynamics of Turbomachinery Elsevier 1998.
- Shaughnessy E.J., Katz I.M., and Schatter J.P., Introduction to Fluid Mechanics, Oxford Uni Press, 2005.
- Heywood, J.; Internal Combustion Engine Fundamentals, McGraw Hill, 1989.
- Cengel Y. and Boles M., Thermodynamics, An engineering approach, SI version, 6th Ed, McGraw-Hill, 2007
- Massey, B.S. Mechanics of Fluids, 8th ed. Taylor & Francis, 2006.
- Cengel J.A., Heat Transfer, A practical approach, McGraw-Hill, 1998
- Ferguson C.R., Kirkpatrick A.T., Internal combustion engines : applied thermosciences. 2nd Ed, Wiley, 2001.
- Martyr A.J. and Plint M.A., Engine Testing, 3rd Ed, Butterworth-Heinemann, 2007
- Heisler, H, Advanced Engine Technology, Arnold, 1995
- Anderson, J.D., Computational Fluid Dynamics, McGraw-Hill, 1995
- Hagen K.D, Heat Transfer with Applications, Prentice Hall, 1999