London South Bank
University

Module Guide

Advanced Thermo fluids and Energy Analysis

EEB_7_305

School of Engineering

Level-7

Template version: 6

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1. UNIT DETAILS

Unit Title:	Advanced Thermo fluids and Energy Analysis
Unit Level:	Level 7
Unit Reference Number:	EEB_7_305
Credit Value:	20
Student Study Hours:	Contact hours: 52, Student managed learning hours: 148
Pre-requisite Learning (If applicable):	Thermofluids and Turbo-machinery *ENG_6_452* or equivalent
Co-requisite Units (If applicable):	None
Course(s):	
Year and Semester	2019-20, Semester 2
Unit Coordinator:	Dr. Abas Hadawey
MC Contact Details (Tel, Email, Room)	7537, hadaweya@lsbu.ac.uk ,T408
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 an opportunity to study applied thermodynamics and fluid mechanics, with emphasis on power-producing devices, energy systems and renewable energy. Experimental techniques for measurement of performance of power-producing devices and fluid mechanic systems will be covered in both theory and practice. Performance prediction of power-producing devices will use techniques ranging from simple models, through to consideration of various numerical simulation techniques. Analysis of energy systems will include appreciation of environmental impact, and students will develop the ability to critically appraise alternative power-producing devices to meet current and future energy needs.

3. AIMS OF THE UNIT

Extend the students' knowledge and understanding of power-producing devices both in terms of the theory of operation, and examples of existing and future real-world solutions.
To introduce students to advanced experimental techniques, required to generate performance characteristics of machines and for validation of numerical simulation models.
To be able to differentiate between various performance prediction technique's including numerical simulation, and be able to apply an appropriate technique to the solution of an energy analysis / power-producing device problem.

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.

Knowledge and Understanding

- Perform analytical heat release analysis of a combustion system, using 1st Law approach and models for heat-transfer. (EA1, EA2m, EA3m, SM1m, SM2m, EP4m)

Intellectual Skills

- Differentiate between 1st Law and analysis and 2nd Law analysis of processes and systems. Be able to describe the concept of Energy, X, and analysis simple thermodynamic systems. (SM1m, SM2m, SM4m, EA1m, EA2m, EA3m, EA4m)

- Be able to derive from first principles the convection transfer equations for velocity, thermal and concentration boundary layers (mass, energy, species) for simplified geometry. (SM1m, SM2m, SM3m, EA1m, EA2m, EA3m)
- Be able to derive the various forms of the continuity, momentum and energy equations for fluid flow for simplified geometry, and convert from one form to another. Solve problems related to fluid flow. (SM1m, SM2m, SM3m, SM4m, EA1m, EA2m, EA3m)

Practical Skills

- Be able to critically appraise energy systems and renewable energy in response to needs, and future proposals. Understand the social, economic and environmental pressure related to energy demand and production, past, present and future. (ET2m, ET4m, ET5m, ET6m, D1m, D3m)
- Be able to select from appropriate experimental and simulation techniques to investigate advanced thermo fluid problems, applied to power-producing devices system (time-resolved data). Apply simple error analysis to measured results. (EP2m, EP3m, EP4m, EP8m, D6m)

5. ASSESSMENT OF THE UNIT

The learning outcomes of the module are assessed through a combination of examination and coursework assignments. Knowledge and understanding of the analytical content will be assessed through examination whilst coursework will assess the application of intellectual and practical skills.

Examination: 70% end of module examination 2hrs. This will be a closed-book exam, but may also include a question based on a predetermined core theme from the taught material. Other questions will be mainly numerical analysis.

Assignment: 30% coursework. The coursework will consist of one assignment with different task including numerical modelling. OR it may also include a laboratory experiment (or results obtained from an industrial experiment), and supported by written report of approximately 1000words

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 applied thermodynamics and fluid mechanics, with emphasis on power-producing devices, energy systems and renewable energy.

7.2 Overview of Types of Classes

Lectures typically of 3hrs duration, complemented by tutorials of 1hr duration which will be supported by example questions, and guideline solutions. Experimental (laboratory) sessions will provide an opportunity to demonstrate some of the advanced experimental techniques, and allow students to develop practical skills in measurement and error analysis.

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. Thermo fluids and Turbo machinery cannot be studied at the last minute; the effort has to be continuous and steady throughout the semester.

7.4 Employability

This module provides the further learning and practical skills required for a career in Thermo fluids and Energy Analysis (including the Energy Sector), and provides the knowledge required to undertake further research in the field of Thermodynamics and Fluid Mechanics.

8. THE PROGRAMME OF TEACHING

Week No	Date	Lecture	Lecture/Tutorial
1	31/01/2020	Introduction / review of undergraduate material (Air Std cycles, Combustion)	Lecture &Tutorial
2	7/02/2020	In-Cylinder Pressure measurement and Heat Release Analysis of a combustion system	Lecture &Tutorial
3	14/02/2020	Advanced Experimental Techniques in Thermofluids	Lecture & Tutorial Assignment (30%, based on experimental techniques & heat-release analysis of provided data) ***Due date end wk5***
4	21/02/2020	Assignment-Internal Combustion Engine-Data Handling	
5	28/02/2020	CFD Conservation and Momentum Equations	Lecture &Tutorial
6	06/03/2020	CFD Numerical Solution & Applications	Lecture &Tutorial
7	13/03/2020	CFD ANSYS-Case Study	Computer Lab.
8	20/03/2020	Analysis of energy systems; 2nd Law & Entropy	Lecture & Tutorial
9	27/03/2020	Analysis of energy systems; Exergy	Lecture &Tutorial
10	03/04/2020	Refrigeration Cycles	Lecture &Tutorial
-	10/04/2020	Easter Holiday	
-	03/04/2020	Easter Holiday	
-	17/04/2020	Easter Holiday	
11	24/04/2020	Convection Heat Transfer	Lecture &Tutorial
12	01/05/2020	Energy Demands Current Solutions & Future Trends Site Visit Field-Trip (CCHP) central-London.	Site Visit
13	08/05/2020	Revision	Lecture &Tutorial
14	15/05/2020	*Note: Please note that the lecture Notes & Tutorials related to EEB_7_305, were prepared with aid of different sources of teaching material including:* ➢ *Books (See the Module Descriptor)* ➢ *Lecture notes from Dr Mark Ellis*	
15	22/05/2020		
16	29/05/2020		
18/05/2020 Semester 2 Exam Week			

Programme of teaching subject to change - content & dates.

9. LEARNING RESOURCES

9.1 Core Materials

- Stone, R, Introduction to Internal Combustion Engines, 4th Ed, Macmillan, 2012.
- Incropera, F. P. and De Witt, Fundamentals of Heat and Mass Transfer, 7th Ed., 2011, Wiley.
- Douglas, Gasiorek, Swaffield ``Fluid Mechanics'' 4th Ed Prentice 2000
- Rogers, G. and Mayhew, Y. Thermodynamics and Transport Properties of Fluids, 5th ed. Blackwell, 1995.
- Thermodynamics: An Engineering Approach (9th Edition, 2018) In SI Units. Yunus Cengel, Michael Boles. ISBN 978-1-260-09268-4 / MHID 1-260-09268-2
- (Steam & Refrigerant -Tables)

9.2 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
- Alternative Energy Sources. Efstathios E. (Stathis) Michaelides, 2012: ISBN 978-3-642-20951-2.