PRIFYSGOL glyndŵr UNIVERSITY

MODULE SPECIFICATION FORM

Module Title:	**Thermo-fluid Mechanics A**	Level:	**5**	Cedit Value:	**10**

Module code: (if known)	**ENG576**	Cost Centre:	**GAME**	JACS2 code:	**H311**

Semester(s) in which to be offered:	**1**	With effect from:	**July 2015**

Office use only: To be completed by AQSU:	Date approved: July 2015 Date revised: Version No: 1

Existing/New: **Existing**	Title of module being replaced (if any): N/A

Originating Academic area: **Engineering and Applied Physics**	Module Leader: **X Huang**

Module duration (total hours)	100	**Status:** core/option/elective (identify programme where appropriate):	**Free-standing 10-credit component comprising first half of ENG538 (Thermo-fluids and Propulsion).**
Scheduled learning and teaching hours	36		
Independent study hours	64		
Placement hours	0		

Percentage taught by Subjects other than originating Subject (please name other Subjects):	**0%**

Programme(s) in which to be offered: **Enginering European Programme** (Non Award Bearing)	Pre-requisites per programme (between levels):	**None**

Module Aims:

To develop understanding of non-flow and flow processes, liquids, vapours and two phase substances, polytropic processes using gases and vapours, the first and second laws of thermodynamics pressure and flow measurement.

Expected Learning Outcomes

Knowledge and Understanding:
At the completion of this module, the student should be able to:

1 Solve problems involving non-flow and steady flow processes;
2. Define the properties of working fluids and hence analyse two phase systems using tables and represent processes on property diagrams; Apply the first and second laws of thermodynamics and compare the performance of real and ideal cycles;
3. Apply the laws of fluid mechanics, Bernoulli's equation and the momentum equation to the flow of incompressible fluids; *(KS 5, 10)*

Key skills for employability

1. Written, oral and media communication skills,
2. Leadership, team working and networking skills
3. Opportunity, creativity and problem solving skills
4. Information technology skills and digital literacy
5. Information management skills
6. Research skills
7. Intercultural and sustainability skills
8. Career management skills
9. Learning to learn (managing personal and professional development, self management)
10. Numeracy

Assessment: *Please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%).*

Assessment is by means of an in-course test covering all outcomes. It is an unseen time-constrained exercise. (The assessment is set independently of the module ENG538. Despite common content, the assessment structures don't match the 10 credit format.)

Assessment number (use as appropriate)	Learning Outcomes met	Type of assessment	Weighting	Duration (if exam)	Word count (if coursework)
Assessment One:	1, 2, 3	In-class test	100%	2 hr	

Learning and Teaching Strategies:

This module will be presented to students through a series of lecture materials including videos, demonstrations and structured technical visits to suitable establishments (e.g.: RAF, Cosford). Laboratory investigations and tutorials will be used to support lectures and to provide an opportunity for students to work on problems with individual attention if needed.

Syllabus outline:

Basic Concepts and the First Law: Concepts of a thermodynamic system and the Zeroth Law. Non-flow and steady flow processes, non-flow energy equation, steady flow energy equationand the continuity equation. Identification of non- flow, steady flow processes. Compression, expansion, adiabatic, heating, cooling constant volume processes. Boilers, condensers, compressors, turbines, nozzles, thottles.

Properties of Pure Sustances and Use of Property Diagrams and Tables: Thermodynamic properties the state and phase of a substance. The formation of wet, saturated and superheated vapour at constant pressure. Thermodynamic property tables and sketches property diagram Extensive and intensive properties. T-h and p-h diagrams.

The relationships between the properties of a perfect gas: Perfect gases and Joule's law. Specific heats of a perfect gas and the relationships between adiabatic index, specific heats and charateristic gas constant. Characteristic gas equation, equations for internal energy and enthalpy of a perfect gas.

Description and analysis of polytropic processes; Polytropic law. Relationships for the work done in various processes. Polytropic, adiabatic and isothermal non- flow processes involving gases and vapours. Steady flow of gases.

The relationship between ideal and actual power plant cycles.: Terms associated with thermodynamic cycles, thermal efficiency. The second law applied to thermodynamic cycles. Constant volume, diesel, gas turbine,carnot,rankineand stirling cycles. Comparision of efficiencies of actual and ideal cycles.

Analysis of heat pump and refrigeration cycles: Reversed Carnot and Rankine cycles. Use of property diagrams. Refrigererants R12 and ammonia. Comparison of ideal and actual cycles.

Principles involved in pressure measurement; Principle of operation of a piezometer, U tube, differential manometers, pitot and pitot-static tubes. Relationships necessary to determine absolute and gauge pressures using the above instruments. Application to static situations and appreciation of application in conjunction with other devices in dynamic situations.

Laws of mechanics, Bernouilli's equation and the momentum equation to the flow of incompressible fluids : Continuity equation and total energy in terms of the various heads; also expressions for flow work and Bernoulli's equation. Various flow measuring devices. Rrate of change of momentum of a fluid between two sections. Pressure, kinetic and potential head. Orifice plates, venturi meters and pitot tubes. Force exerted on a stationary or moving flat plate or curved vane by a jet. Relates the force exerted by a jet to the power developed by a water turbine.

Bibliography:

Essential Reading:

Cengel, Y.A. et al. (2008) *Fundamentals of Thermal-Fluid Sciences*, 3rd Edn (SI units), McGraw-Hill Higher Education.

Douglas, J.F. et al. (2011) *Fluid Mechanics*, 6th Edn., Prentice Hall.

Recommended reading:

Crowe, C.T., Elger, D. F., Williams, B.C. and Roberson, J.A., (2009) *Engineering Fluid Mechanics*, 9th Edn., John Wiley & Sons.

Eastop, T.P. & McConkey, A. (1998) *Applied Thermodynamics for Engineering Technologists*, 5th Edn., Singapore: Longman.