PRIFYSGOL glyndŵr UNIVERSITY

MODULE SPECIFICATION FORM

Module Title:	**Thermo-Fluid Mechanics C**	Level:	**6**	Credit Value:	**10**

Module code: (if known)	**ENG602**	Cost Centre:	**GAME**	JACS2 code:	**H311/H321**

Semester(s) in which to be offered:	**2**	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: **C Abeykoon**

Module duration (total hours)	100	**Status:** core/option/elective (identify programme where appropriate):	**Free-standing 10-credit component comprising half of ENG616 (Advanced Thermo-Fluids and Turbomachinery).**
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:

This further extends the knowledge of thermodynamics and fluid mechanics from Thermo-Fluids B into applied studies, including the in-depth investigation of the areas of heat transfer, combustion, fluid flow and turbo-machinery.

Expected Learning Outcomes

Knowledge and Understanding:

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

1. Use dimensional analysis and model testing and apply the principles of heat energy transition; (KS 4)
2. Analyse the operation of heat exchangers of various designs' process of combustion; (KS 3)
3. Apply principles of analysis of the flow of a two dimensional ideal fluid to analysis of the flow of real fluids;
4. Analyse the design and operation of rotodynamic machines. (KS 3, 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 examination covering all outcomes. It is an unseen time-constrained exam. (This corresponds to one-half (part A) of the examination of ENG616.)

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

Learning and Teaching Strategies:

This module will be presented to students through a series of lecture materials including videos, demonstrations, investigations and structured technical visits to large energy users.

Syllabus outline:

Dimensional analysis: Dimensional reasoning and fundamental and derived units and dimensions. Relationships by dimensional analysis. Group method of dimensional analysis (Buckingham's pi theorem). Use of dimensionless groups in investigative work. Geometric and dynamic similarity . The use of model studies in various applications.

Fundamentals of Heat Transfer: Steady state conductive heat transfer. Heat transfer through a single thickness of material and walls. One dimensional heat transfer through several thicknesses of different materials. Composite walls. Convective heat transfer, forced and natural convection. Dimensional analysis. Thermal radiation, absorptivity, reflectivity and transmissivity in relation to radiation. Black body radiation and the Stefan-Boltzman Law. Kirchoff's Law. Grey bodies and practical problems.

Heat Exchangers: Parallel flow heat exchangers and design calculations. Counterflow heat exchangers and design calculations. Heat transfer units (NTU method).

Combustion of Fuels: Chemical equations for the combustion of common elements and fuels. Stoichiometric air to fuel ratio. Analysis, by mass and by volume, of products of combustion of various liquid and gaseous fuels. Properties of fuels, determination of calorific values.

Potential Flow: The properties of an ideal fluid, the general equation for continuity in an ideal fluid flow. 'Stream Function' and equations for the velocity components of flow - cartesian and polar co-ordinates. Circulation, vorticity, rotational and irrotational flow. 'Velocity Potential' and equations for the velocity components of flow.

The Flow of Real Fluids: The viscous (or laminar) flow of fluids, equations for the steady viscous flow of fluid in pipes. Volume flow rate and the loss of head for a steady viscous flow of fluid in pipes. Equations for the volume flow rate, maximum velocity and mean velocity of the steady viscous flow of a fluid between parallel plates. Turbulent flow in pipes and representation of the velocity distribution, the relationship between 'friction factor' and Reynolds number, the effect of pipe roughness on the friction factor.

Bibliography:

Essential reading:

Cengel, Y.A. and Boles, M. (2010) *Thermodynamics: An Engineering Approach,* McGraw-Hill.

Recommended reading:

Rogers and Mayhew (1995) *Thermodynamic and Transport Properties of Fluids*, Blackwell.
Joel, R. (1995) *Basic Engineering Thermodynamics*, Longman.
Massey (2000) *Mechanics of Fluids*, Van Nostrand Reinhold.
Douglas et al (1995) *Fluid Mechanics*, Longman.
Thomas (1993) *Heat Transfer*; Prentice-Hall.