Module Proforma

Approved, 2022.01

Summary Information

Module Code	6559USST
Formal Module Title	Fluid Dynamics & Heat Transfer
Owning School	Engineering
Career	Undergraduate
Credits	10
Academic level	FHEQ Level 6
Grading Schema	40

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Dante Matellini	Yes	N/A

Module Team Member

Contact Name	Applies to all offerings	Offerings

Partner Module Team

Contact Name	Applies to all offerings	Offerings

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
University of Shanghai For Science and Technology

Learning Methods

Learning Method Type	Hours
Lecture	11
Practical	3
Tutorial	11

Module Offering(s)

Offering Code	Location	Start Month	Duration
SEP-PAR	PAR	September	12 Weeks

Aims and Outcomes

Aims	The module aims to further develop the essential principles of Fluid Dynamics and Heat Transfer.

Learning Outcomes

After completing the module the student should be able to:

Code	Description
MLO1	Solve practical fluid flow problems.
MLO2	Calculate flow parameters and aerodynamic forces.
MLO3	Analyse conduction, convection and radiation heat transfer phenomena.

Module Content

Outline Syllabus

1. Introduction to viscous flow - Overview of viscous flow; Fluid properties; Viscosity; Newtonian / non-Newtonian fluid.

2. Governing equations of viscous flow - Continuity equation (Conservation of mass); Navier-Stokes equation (Conservation of momentum).

3. Application of equations of viscous flow - Poiseuille channel flow; Couette flow; Pipe flow.

4. Application of equations of viscous flow boundary layer - Prandtl's boundary layer equation (physical and mathematical descriptions); Blasius (exact) solution of the boundary layer; Approximate solution of the laminar boundary layer; Approximate solution of the turbulent boundary layer.

5. Aerodynamic forces and some corresponding phenomena - Calculation of lift and drag forces; Flow separation; Turbulent flow control; Structure of turbulent flow over smooth and rough surfaces.

6. Introduction to heat transfer - Overview of heat transfer phenomena and recapitulation of underlying physics.

7. Conduction heat transfer - Fourier's law; Conduction equation in cartesian and polar coordinates; Thermal resistances; Overall heat transfer coefficients; Finite difference methods for steady state and transient conduction problems.

8. Convection heat transfer - Boundary layer flows; Fluid flow similarities; Newtonian heating; Forced convection on internal and external surfaces; Free convection; Heat transfer correlations.

9. Radiation heat transfer - Absorptivity, Transmissivity and Reflectivity; Stefan Boltzman law; Black and grey body radiation; View factors; Radiation exchange between grey surfaces; Radiation networks.

Module Overview

Additional Information

This module takes an in-depth look into the governing equation and theory of the complex area of fluid flow and heat transfer. The underpinning ideas are delivered by lectures and tutorials which requires the student to have a fundamental understanding of the principles and how to apply them to practical situations.

This module includes content which relates to the following UN Sustainable Development Goals. Knowledge of fluid dynamics and heat transfer has become an essential knowledge in the design process of any problem involving fluid flow and heat transfer phenomena. Therefore, the following UN Sustainable Development Goals are, in part, considered:

SDG3 – This module considers calculation of flow parameters for internal flows. An example of the internal flows is blood flow in the arteries and air flow through lungs.
SDG7 – The module considers solving fluid dynamics and heat transfer problems which are involved in the design of systems that provide affordable and clean energy (e.g. nuclear reactors, wind turbines, tidal stream turbines).
SDG9 – The knowledge that is learnt on this module, is used in industry, innovation (novel products) and infrastructure.
SDG11 – The module considers calculation of flow parameters over a wide range of internal and external flows, which are used in the design of sustainable cities and communities whether it be considering the wind profile through large buildings or sewer system.
SDG13 – Fluid dynamics and heat transfer are involved in a wide range of the systems that provide for clean, renewable energy supplies playing a role in climate action.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Learning Outcome Mapping
Exam	Examination	70	2	MLO1, MLO2, MLO3
Test	Online Test	30	0	MLO1, MLO2, MLO3