Liverpool John Moores University

Title:	Mechanical and Thermal Systems 1b
Status:	Definitive
Code:	**4104MAN** (121952)
Version Start Date:	01-08-2021
Owning School/Faculty:	Engineering
Teaching School/Faculty:	Engineering

Team	Leader
Ariyan Ashkanfar	Y
Guangming Zhang	
Mike Morgan	

Academic Level:	FHEQ4	**Credit Value:**	20	**Total Delivered Hours:**	46
Total Learning Hours:	200	**Private Study:**	154		

Delivery Options
Course typically offered: Semester 1

Component	Contact Hours
Lecture	33
Tutorial	11

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	AS1	Coursework - VLE based tests	40	
Exam	AS2	Examination	60	2

Aims

To provide an introduction to the mechanical behaviour of solid bodies under the influence of applied forces; energy transfers of thermodynamic processes' and properties of fluid flow for engineering problems.

Learning Outcomes

After completing the module the student should be able to:

1	Use the principles of equilibrium to analyse coplanar static force systems.
2	Apply the concepts of stress and strain to simple engineering problems involving axial, shear, flexural and torsional loading.
3	Analyse thermodynamic processes and cycles involving gases and vapours.
4	Apply the governing equations of fluid dynamics for simplified fluid flow.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Coursework - VLE basd tests	1	2	3	4
Examination	1	2	3	4

Outline Syllabus

1 Statics

Static force systems
Planar force systems. Statics of a particle (addition of forces [graphical, force components], resultant force, condition for static equilibrium). Statics of rigid bodies (moment of a force, free-body diagrams, condition for static equilibrium). Application to connected bodies. Application to planar pin-jointed frameworks. Friction.

Flexurally loaded beams
Shear force and bending moment distribution in flexurally loaded beams. Development of shear force and bending moment diagrams for beams subject to concentrated and uniformly distributed loading.

2 Strength of Materials

Concepts of stress and strain
Axial and shear loading. Calculation of stresses and deformation (strain) in components subject to axial and shear loading. Review of load-deformation behaviour of materials (tensile test, Young's Modulus, Poisson's Ratio, yield stress, tensile strength, shear strength). Application to design and structural integrity.

Flexural loading. Calculation of bending stresses in beams (simple theory of elastic bending). Calculation of deflection in beams (direct integration, Macaulay's methods). Shear stresses in beams resulting from bending.

Torsional loading. Calculation of shear stresses in circular section shafts (theory of pure torsion).

Stress concentration. Stress concentration factor kt. Use of charts to determine kt. Factor of safety. Design stresses.

3 Thermodynamics

Thermodynamic processes: polytropic, isentropic, isochoric, isobaric and isothermal; process diagrams and variation of the polytropic index; examples of thermodynamic cycles.
Gibbs - Dalton law of partial pressures; properties of mixtures, Amagat's law of partial volumes; volumetric and gravimetric analysis of gas mixtures.
Properties of vapours; phases of matter: solid, liquid and gaseous; nomenclature for matter properties and phase transitions; property diagrams for phase change processes.
Steam power engineering; processes and components of a simplified steam power plant; dryness fraction and steam property diagrams; steam calculations with use of steam tables.
Introduction to irreversibility of real processes; heat engines and statements of 2nd law of thermodynamics; introduction to entropy and isentropic efficiencies.

4 Fluid Mechanics

Pipe flow meters: Venturi, nozzle and orifice plate; Bernoulli's and continuity equations applied to flow meters; coefficients of discharge, contraction and velocity.
Pitot tubes: simple Pitot, static source and Pitot-static tubes; free surface flow and siphoning processes; losses in pipes, power of pumps and turbines.
Force exerted by a fluid jet and the momentum equation; applications: stationary and moving vanes; restricting pipe bends and jet propulsion.
Base quantities and their SI units and dimensions; principle of dimensional homogeneity and similarity; Rayleigh's method of dimensional analysis.
Introduction to real viscous fluid flow, laminar and turbulent flows; Reynolds number and velocity profiles in pipes; frictional losses in pipes and the Moody chart.

Learning Activities

Lectures, tutorials and private study.

Notes

The module will provide students with an introduction to essential applied mechanics (static force systems, strength of materials) and thermodynamics and fluid mechanics (thermodynamic processes, properties of steam, governing equations of simplified fluid flow).

In this module, the knowledge learning outcomes are K3.