Liverpool John Moores University

Title:	Mechanical and Thermal Systems 1a
Status:	Definitive
Code:	**4103MAN** (121948)
Version Start Date:	01-08-2021
Owning School/Faculty:	Engineering
Teaching School/Faculty:	Engineering

Team	Leader
Milad Armin	Y
Russell English	
Geraint Phylip-Jones	

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

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Lecture	33
Tutorial	11

Grading Basis: 40 %

Assessment Details

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

Aims

To introduce the essential principles and fundamental concepts of applied mechanics, thermodynamics and fluid mechanics and their application to engineering problems.

Learning Outcomes

After completing the module the student should be able to:

1	Apply the principles of kinematics and dynamics to problems of motion.
2	Apply the principles of work, energy, power, impulse and momentum to the solution of engineering problems
3	Apply the first law of thermodynamics to open and closed systems.
4	Apply the hydrostatic equation to incompressible fluids at rest and simplified fluid flow.

Learning Outcomes of Assessments

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

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

Outline Syllabus

1 Dynamics

Kinematics. Review of kinematics of rigid bodies. Linear and angular motion with uniform acceleration. Linear – angular motion relationships. Projectile motion.

Graphical representation and interpretation of kinematic data, application to linear and simple non-linear motion, the application of calculus in the analysis of linear and nonlinear motion.

Dynamics of rigid bodies. Newton's laws of motion and their application to simple mechanical systems including linear and rotational motion. Concepts of force, mass, weight and inertia, D'Alembert's Principle, Friction, Torque and moment of inertia. Applications. Connected bodies.

2 Energy Methods

Concept of work. Work done by uniform and non-uniform forces. Work done by a torque. Springs.

Concept of Energy. Kinetic energy and the work-energy equation. Potential energy. Strain energy. Conservation of energy. Kinetic energy of rotation.

The notion of power. The power associated with a moving force and a torque. Efficiency. Applications.

Impulse and momentum: Definition of impulse and linear momentum. Temporally varying forces. Conservation of linear momentum. Impulsive forces. Angular momentum and impulse. Applications of impulse and momentum to impact and restitution: Collision of two bodies. collision of perfectly elastic bodies. Partially

elastic collisions. Inelastic collisions.

3 Thermodynamics

Brief introduction to thermodynamics and energy transfer; base and derived physical quantities, SI units and dimensions; dimensional homogeneity and magnitude prefixes.
Thermodynamic terminology and properties of systems; zeroth law, absolute pressure and temperature; change in energy, work transfer and heat transfer.
Thermodynamic states, processes and cycles; energy conservation, first law of thermodynamics; first law applied to closed systems (Non-Flow Energy Equation).
Enthalpy, flow work and energy of flowing fluids, first law applied to open systems (Steady-Flow Energy Equation); application the continuity equation (conservation of mass).
Laws of perfect / ideal gases; equation of state for an ideal gas in various forms; Avogadro's Hypothesis, molar mass and amount of substance.

4 Fluid Mechanics

Relevance of fluid mechanics, continuum concept; Newtonian fluids, viscosity and compressibility; hydrostatics and derivation of the hydrostatic equation.
Manometry, pressure measurement and hydrostatic equation; piezometers, U-tube, differential and inclined manometers; surface tension, wetting, menisci and capillary rise.
Floating bodies, buoyancy and Archimedes' principle; hydrostatic forces on submerged surfaces; centroid, centre of pressure, horizontal and vertical forces.
Ideal fluids, flow visualisation and velocity profiles; steady and unsteady flow, compressible and incompressible; types of flow: one, two and three dimensional.
Conservation of mass and the continuity equation; the Euler equation and derivation of Bernoulli's equation; energy, pressure and head forms of Bernoulli's equation

Learning Activities

Lectures, tutorials and private study.

Notes

The module will provide students with an introduction to essential applied mechanics (dynamics, work, energy and power, impulse and momentum) and thermodynamics and fluid mechanics (thermodynamic laws, energy transfers, fluid properties and hydrostatics).