Liverpool John Moores University

Title:	Applied Mechanics, Materials and Manufacture
Status:	Definitive
Code:	**4503ENGIYO** (120263)
Version Start Date:	01-08-2016

Owning School/Faculty: Maritime and Mechanical Engineering
Teaching School/Faculty: Study Group

Team	Leader
Christian Matthews	

Academic Level:	FHEQ4	**Credit Value:**	20	**Total Delivered Hours:**	92
Total Learning Hours:	200	**Private Study:**	108		

Delivery Options

Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	60
Tutorial	30

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	AS1	Exam	70	2
Test	AS2	Test	30	

Aims

To introduce the essential principles of applied mechanics.

To introduce the essential principles of material science, applications and processing methods of different material groups.

Learning Outcomes

After completing the module the student should be able to:

1   Apply the concepts of stress and strain to simple engineering problems involving axial, shear, flexural and torsional loading
2   Apply the principles of kinematics and dynamics to problems of motion
3   Apply the principles of work, energy, power, impulse and momentum to the solution
     of engineering problems
4   Review the range of available materials, their applications and properties and demonstrate knowledge of the basic structures of different groups of materials
5   Apply different materials testing and analysis data methods for design and product Development
6   Demonstrate knowledge of materials and processing methods

Learning Outcomes of Assessments

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

| Exam | 1 | 2 | 3 | 4 | 5 | 6 |

| Test | 1 | 2 | 3 | 4 | 5 | 6 |

Outline Syllabus

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.

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.

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 andnonlinear 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.

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.

Materials
Materials Structures and Applications
Structure of atoms, Bohr theory. Primary and secondary bondings and their relationships with material properties.
Classification of engineering materials: metals, ceramics, polymers and composites and typical applications.
Ideal crystalline solids: basic crystallography.
Microstructure of metals and ceramics: grains, grain size, defects and their influence on mechanical and physical properties.

Structure of polymers: molecule chains, curing, thermoplastic and thermosets

Properties, testing and selection
Materials properties and design: stiffness. strength and toughness; stress strain curves, Young's modulus, yield strength, toughness, fracture toughness.
Factors affecting the behaviour and properties of materials.
Destructive and non-destructive tests; tensile, hardness, ductile and brittle failure. Analysis and interpretation of materials testing data.
Material selection: Introduction to computer-based techniques for material selection.

Manufacturing
Metal materials and processing
Classification of materials processing methods: forming, shaping, and processing.
Casting processes: Fluid flow and solidification; casting mould design; prevention of

casting defects.
Metal cutting processes: Milling, turning and grinding theory, preparation of data and tool selection.
Overview of cold working process of metals.

Processing of plastics and composites
Fundamentals of moulding processes of plastics and composites.
Injection moulding, compression moulding, blow moulding, vacuum forming
Rapid prototyping and 3D printing methods
Mould design

Learning Activities

Lecture, demonstration and practical activities

Notes

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