Liverpool John Moores University

Title:	Materials and Manufacturing Processes
Status:	Definitive
Code:	**4005PDE** (120080)
Version Start Date:	01-08-2016
Owning School/Faculty:	Electronics and Electrical Engineering
Teaching School/Faculty:	Electronics and Electrical Engineering

Team	Leader
Adam Papworth	Y

Academic Level:	FHEQ4	**Credit Value:**	20	**Total Delivered Hours:**	72
Total Learning Hours:	200	**Private Study:**	128		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	36
Practical	12
Tutorial	24

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	Test	Materials exam	50	
Presentation	Present	Materials presentation	50	

Aims

Provide an understanding of the properties of materials and manufacturing processes to develop a product.

Learning Outcomes

After completing the module the student should be able to:

1 Determine the properties and selection criteria of materials from tests and data sources
2 Define the relationships between manufacturing processes and material behaviour
3 Select suitable materials and processing methods for a specific product
4 Identify the in-service causes of failure of engineering materials

Learning Outcomes of Assessments

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

Materials Test	1	2
Materials Presentation	3	4

Outline Syllabus

Module introduction
Module guide; aims; learning outcomes; assessment and marking schemes. Outline syllabus; module timetable and student feedback.

Be able to determine the properties and selection criteria of materials from tests and data sources.

Criteria for material selection: definitions of material properties and e.g. mechanical, physical, and chemical, process characteristics and costs for range of materials (metals, ceramics, polymers, and composites).
Categorise materials: an appreciation of the properties of metals, ceramics, polymers and composites; recognition of micro-structural characteristics of the more commonly used engineering materials.
Materials testing: tests to determine the properties of commonly used engineering materials
e.g. metals, ceramics, polymers and composites (such as mechanical strength, hardness, toughness, fatigue and creep resistance, corrosion and reactivity, wear resistance, optical and thermal properties, formability); appropriate statistical methods and the processing of test data sources: published data e.g. British Standards, ISO, product data sheets, IT sources, standard published data sources, manufacturers' literature, job-specific information such as specifications, test data and engineering drawings; assessment of data reliability.

Understand the relationships between manufacturing processes and material behaviour.

Treatment processes: heat treatments e.g. quench and precipitation hardening processes, glass transitions; surface treatments/surface engineering, polymer treatments, composites/powder produced materials, matrix/reinforcement relationships.

Liquid processing: metal casting and injection moulding/extrusion of polymers; effect

of processing on structure and properties e.g. grain structure, porosity.

Mechanical processing: effect on structure and properties illustrated by a range of processes
e.g. mechanical working of metals, powder processing of metals and ceramics, extrusion and forming of polymer sheet, welding, use of adhesives; effect of processing on structure and properties e.g. residual stresses, work hardening.

Composition and structure: e.g. alloying, co-polymerisation; additives, cross-linking, crystallinity, lattice structure, slip planes and their effect on properties of parent material.

Be able to select suitable materials and processing methods for a specific product.

Design constraints: e.g. working conditions such as applied forces, environment, electrical/magnetic requirements, shape, form and function of the product.

Materials, properties and processing: inter-relationship between product design, material selection and processing methods; merit index/index of suitability; ability to be re-used.
Processing limitations: effects of the manufacturing processing capabilities on the structure of materials and preventing or facilitating product design, effect on environment (such as sustainability, emissions, energy conservation).

Understand the in-service causes of failure of engineering materials.

Causes of failure: failure of material categories (metals, ceramics, polymers and composites) e.g. creep, fatigue, S-N curves; modification factors due to geometric, surface and environmental factors.impact, overstressing, corrosion, temperature, thermal cycling, residual stresses, stress relaxation, degradation (composition change), radiation, electrical breakdown, or combinations of these.

Service life: contributory effects of service conditions to failure e.g. inappropriate maintenance, inappropriate use, faults in manufacture, changes in service conditions such as environment, loading and temperature.

Estimation: methods of investigating failure and the preparation of estimates of product service life that require the use of calculations e.g. creep or fatigue failure.

Improving service life: recommending remedial and/or preventative measures e.g. changes to material, product design, protective systems for corrosion and degradation, adjustment loading and working temperature.

Learning Activities

This module will be delivered through an integrated series of lectures, tutorials, practical sessions, guided design activities and case studies. The learning activities are to be student focused and develop the students design knowledge through experiential learning.

Notes

This module is delivered using a variety methods including lectures, seminars, tutorials and practical sessions. The module will be delivered from a engineering and product design perspective.