

Module Catalogue

MSc (Eng) and PGDip. in Automotive Engineering (8665/4)

The MSc (Eng) programme comprises 80 credits of taught material plus a substantial Professional Engineering Project worth a further 40 credits. The PG Diploma comprises 60 credits of taught material plus a Technical Engineering Project worth a further 20 credits

Compulsory Modules	
Semester 1	Semester 2
MECH5821: Professional Project (40 credits) For Masters Students Only MECH5822: Technical Engineering Project (20 credits) For Postgraduate Diploma Students Only Although the majority of the Project work associated with this module is conducted between the end of the Semester 2 and September, students commence work at the start of Semester 1.	

The optional taught modules are chosen by the student from the list below with the approval of the Programme Tutor. In semester 1, candidates are advised to select 40 optional credits from the semester 1 list below. In semester 2, Postgraduate Diploma students select 20 optional credits while Masters Students select 40 credits from Semester 2 list.

Optional Modules	
Semester 1	Semester 2
MECH5165: Vehicle Design & Performance (10 credits)	MECH5155: Finite Element Analysis: Advanced Techniques & Applications (10 credits)
MECH5185: Automotive Chassis Engineering (10 credits)	MECH5180: Vehicle Ride & Handling (10 credits)
MECH5330: Competitive Product Design (10 credits)	MECH5195: Automotive Drivetrain Engineering (10 credits)
MECH5510: Computational & Experimental Methods (10 credits)	MECH5215: Aerodynamics (10 credits)
MECH5370: Exploiting Innovative Solutions (10 credits)	MECH5230: Computational Fluid Dynamics (10 credits)
MECH5410: Surface Engineering (10 credits)	MECH5245: Engine Tribology (10 credits)
	MECH5265: Combustion in Engines (10 credits)
MECH5140: Racecar Chassis Engineering (20 credits)	

Module Descriptions

Mech 5140: Racecar Chassis Engineering

Sem	1&2	Credit	20	Level	5	Tutor	Prof DA Crolla	Pre-Requisites	Equivalent of BEng (Hons) degree in engineering
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Form of teaching

Lectures from academics and industrialists; Case studies (3); Practical classes – to learn software packages; Project/assignment supervision meetings

Form of assessment

10% 3 case studies; 50% 3 assignments on each of the above topics; 40% 1 x 2 hour examination

Syllabus

Overall design principles for racing cars:

- design specification, cost / weight / stiffness trade-offs
- maximising acceleration
- braking and cornering performance
- chassis balance to extract maximum tyre capability

Chassis Structural Design

- single seater racing cars, special considerations
- principles, monocoque vs. spaceframe
- materials, properties, weight reduction, structural efficiency
- loading, torsional/bending stiffness, load input points, static/dynamic loads
- crashworthiness, rollover protection, driver protection

Suspension Design

- racing car requirements
- effect on ride and handling dynamics
- kinematic analysis
- compliances, non-linear effects
- effect of springs/dampers on steady state and transient handling
- forces in members
- materials, suspension component design

Aerodynamic Design

- principles, airfoils, wings, racing requirements
- wind tunnel testing, scaling, measuring techniques
- wing design, front/rear balance, ground effects
- cooling air management
- flow around rotating wheels

For each of these subject areas, a computer-aided engineering package will be introduced and used as part of the assignments. The 3 packages will be linked to:

- Finite Element Analysis (FEA)
- Multibody System Dynamics (MBS)
- Computational Fluid Dynamics(CFD)

Books

Aerodynamics of Road Vehicles, W H Hucho (Ed), SAE, 1998 (4th edition)

Chassis Engineering, H Adams, HP Books, 1993

Competition Car Suspension, A Staniforth, Haynes, 1994

How to Make Your Car Handle, F Puhn, HP Books, 1981

Performance Handling, D Alexander, Motorbooks International, 1990

Race and Rally Car Source Book, A Staniforth, Haynes, 1992 (3rd Ed)

Race Car Aerodynamics, J Katz, Robert Bentley Publ., 1995

Racecar Vehicle Dynamics, W.F.Milliken and D F Milliken, SAE, 1995

Road Vehicle Aerodynamic Design, R H Barnard, Longman, 1996

Mech 5155: Finite Element Analysis: Advanced Techniques and Applications

Sem	2	Credits	10	Level	5	Tutor	Dr PC Brooks	Pre-Requisites	Mech3105 or equivalent
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Form of Teaching

Lectures 29 x 1 hour; Seminar 1 hour; 3 x 1 hour supervision of assignments

Form of Assessment

1 x 2 hour examination 50%; 2 assignments 20% & 30%

Syllabus

The process of finite element analysis:

- The creation of a mathematical idealisation of the real structure
- The development of the finite element model, assumptions, choice of element type, constraints and convergence of mesh

Finite element systems:

- Role of finite element analysis in engineering
- Integration of design and analysis
- Quality assurance and commercial codes

Model verification:

- The need for verification
- Alternative theoretical approaches
- Experimental

Advanced analysis applications:

- Analysis of dynamic problems, differences between static analysis and dynamic, the free vibration problem, transient problems
- Contact analysis, types of contact, methods of analysis
- Structural optimisation, review of optimisation methods and their application to example problems
- Material models, elastic models, elastic-plastic behaviour, models used assist in the analysis of impact

Books

Fagan, M J, Finite element analysis theory and practice. Longman, 1996.

Mottram & Shaw, Using finite elements in mechanical design. McGraw Hill, 1996.

Lewis and Ward, The finite element method: Principles and applications. Longman, 1992.

Mech 5165: Vehicle Design and Performance

Sem	1	Credits	10	Level	5	Tutor	Dr Brooks PC	Pre-Requisites	Equivalent of BEng (Hons) degree in engineering or related subject
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Form of teaching

Lectures 26 x 1 hour; Tutorials 7 x 1hour

Form of assessment

1 x 2 hour examination 75%; 2 assignments each worth 12.5 %

Syllabus

Vehicle Mechanics:

- Modelling philosophy
- Co-ordinate systems
- Axle loads of vehicle and vehicle/trailer combinations
 - static and dynamic conditions

- rear wheel, front wheel and 4 wheel drive
- Forces

Road loads:

- Generation of aerodynamic loads on vehicles
- Road loads due to aerodynamic forces
- Aerodynamic design of vehicles
- Load transfer due to cornering
- Roll over stability

Acceleration behaviour:

- Tractive resistance and tyre properties
- Engine characteristics
- Transmission characteristics
 - Clutch, gearbox, driveline, differential and transfer box
- Traction and power limited calculations
- Fuel economy calculations

Deceleration behaviour:

- Overview of the brake system
- Kinematic analysis of a braking vehicle
- Driver-vehicle braking model
- Brake proportioning
- Efficiency and adhesion utilisation
- Standards and legislation

Books

Gillespie, T D, Fundamental of vehicle dynamics, SAE, 1992
 Lucas, G G, Road vehicle performance, Gordon and Breach, 1986.
 Limpert, R, Brake design and safety, SAE, 1992.

Mech 5180: Vehicle Ride and Handling

Sem	2	Credits	10	Level	5	Tutor	Prof DA Crolla	Pre-Requisites	Appropriate 1 st degree
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Form of teaching

Lecture 30 x 1 hour; Seminars 6 hours

Form of assessment

One 2 hour examination (75%); 1 assignment 25%

Syllabus

Ride behaviour and suspension design

- road roughness characteristics
- performance criteria; driver comfort, suspension working space, handling implications, body attitude control,
- mathematical modelling; generation of predicted results,
- interpretation of results; practical suspension design guidelines,
- advanced suspensions; costs/benefits of various active suspension designs.
- extension of quarter car model to half and full vehicle models

Handling dynamics

- tyre behaviour; generation of forces and moment
- simple vehicle handling model
- understeer/oversteer, steady turning behaviour
- stability during straight, high speed running
- forced responses to driver steering inputs
- vehicle design guidelines to promote good handling; vehicle layout, suspension, tyre choices

- extension of model to include roll degree of freedom handling measurements
- handling of vehicle combinations

Books

An introduction to Vehicle Dynamics. D A Crolla, G R Firth & D N L Horton, University of Leeds, 1992 (copies from lecturer and in the Departmental Library).

Tyres, Suspension and Handling, J C Dixon, CAMBRIDGE UNIVERSITY PRESS, 1991.

Fundamentals of Vehicle Dynamics.. T D Gillespie, SAE, 1992.

Vehicle Handling Dynamics. J R Ellis, MECHANICAL ENGINEERING PUBLICATIONS, 1994.

The Motor Vehicle. 11th Edition, K Newton, W Steeds & T K Garret, BUTTERWORTHS, 1989.

Advanced Vehicle Technology. H Heisler, EDWARD ARNOLD, 1989.

Automotive Handbook, (3rd Edition)

Mech 5185: Automotive Chassis Engineering

Sem	1	Credits	10	Level	5	Tutor	Prof Barton	DC	Pre- Requisites	Equivalent of BEng (Hons) degree in engineering
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Form of teaching

Lectures 27 x 1 hour; Tutorials 6 x 1 hour

Form of assessment

One 2 hour examination 75%; 2 assignments each worth 12.5%

Syllabus

Suspension systems and components:

- Introduction to vehicle suspensions
- Suspension types
- Suspension components and their characteristics, design and selection
 - springs
 - anti roll bars
 - dampers
 - bushes
- Kinematic and force analysis
- Antisquat and antidive geometries

Steering systems:

- Review of designs
- Handling requirements and regulations
- System geometry and kinematics
- Bump, roll and compliance steer
- Forces - stationary and moving vehicles
- Four wheel steer

Noise and vibration harshness (NVH):

- Fundamentals of acoustics
- Subjective response to noise
- Automotive vibration - sources, modelling and control
- Automotive noise - sources, criteria and control

Chassis structure:

- Review of vehicle structures
- Analysis of car body structures
- Safety under impact

Books

Newton, K, Steeds W, Garrett, T K, *The Motor Vehicle*, Butterworths, 1989.

Fenton, J, Handbook of Vehicle Design Analysis, MEP, 1996, ISBN 0-8529-8963-6.
 Automotive Handbook (3rd Edition) Robert Bosch GmbH, Stuttgart, 1993, (sold under license by SAE),
 ISBN 1-56091-372-X.

Mech 5195: Automotive Drivetrain Engineering

Sem	2	Credits	10	Level	5	Tutor	Dr PC Brooks	Pre-Requisites	Equivalent of BEng (Hons) degree in engineering
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Form of teaching

Lectures 25 x 1 hour; Tutorials 8 x 1 hour

Form of assessment

One 2 hour examination 75%; 2 assignments, each work 12.5%

Syllabus

Introduction

- Overview of the drivetrain
- Description of components within the context of the drivetrain

Clutches

- Performance during engagement
- Thermal properties

Transmissions

- Manual gearbox systems
- Lubrication of gears
- Gearbox synchronisers
- Hydrokinetic transmissions
- Automatic gearboxes
- Continuously variable transmissions and traction control

Belt drives

- Fundamentals of power transmission for flat, vee and vee ribbed belts
- Efficiency
- Synchronous belts

Brakes

- Review of designs
- Brake torque calculations
- Thermal properties
- Noise and vibration
- ABS

Drivetrain NVH

- Approaches to the dynamical modelling of the drivetrain
- Performance
- Refinement issues

Books

Baker, A K, Vehicle braking, Pentech Press, 1986

Baker, A. K, Industrial brake and clutch design (A Ferodo design manual), Pentech Press, 1992, ISBN 0-7273-0603-0.

Fenton, J, Handbook of Vehicle Design Analysis, MEP 1996, ISBN 0-8529-8963-6

Limpert, R, Automotive Brake Systems (1st Edition, Robert Bosch GmbH, Stuttgart, 1995 (sold under licence by S.A.E.). ISBN 0-8376-0331-5.

Limpert, R, Brake design and safety. Society of Automotive Engineers, 1992, ISBN 1-56091-261-8

Newcomb, T. P.; Spurr, R. T, Braking of road vehicles, Chapman and Hall, 1976 (out of print).

Newcomb, T. P.; Spurr, R. T, Torsional vibrations in the drive train. LuK GmbH, Baden, 1990 (4th International Clutch Symposium).

Puhn, F, Brake Handbook, HP Books, 1985. ISBN 0-89586-232-8.

Mech 5215: Aerodynamics

Sem	2	Credits	10	Level	5	Tutor	Dr HM Thompson	Pre-Requisites	Mech2270
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Form of teaching

Lectures (24 x 1 hour); Practical classes (2 x 15 hour assignments)

Form of assessment

One 2 hour examination (75%); Two assignments (25%)

Syllabus

Background/Fundamentals:

- Inviscid 2-D flow equations, definition of stream function, vorticity and irrotational flow.
- Standard irrotational flows: source, sinks and point vortex.
- The complex potential, circulation and the Kutta-Joukowski theorem.
- Effects of viscosity: boundary layers and separated flow.

Aircraft Aerodynamics:

- 2-D flow over airfoils: lift, drag and strategies for avoiding separation.
- Panel methods for irrotational flow past bodies.

Vehicle Aerodynamics:

- Historical development and similarities/differences with aircraft aerodynamics.
- Forces and moments acting on a vehicle.
- Design factors influencing aerodynamic drag and top speeds.
- Importance of lift and design features for its minimisation.
- Negative lift devices.
- Aerodynamic stability: simple rules for good stability.
- Applications and current limitations of CFD in automotive design.

Books:

Glauert, H: The elements of aerofoil and airscrew theory, C.U.P, 1959.

Hucho, H: Aerodynamics of road vehicles, 1986, ISBN 0-408-01422-9.

Anderson, J D: Fundamentals of aerodynamics, McGraw-Hill, 1984, ISBN 0-07-001656-9.

Houghton, E L, Carruthers, N B: Aerodynamics for engineering students, 1982, ISBN 0-7131-3433-X.

Barnard, R H: Road vehicle aerodynamic design, 1996, ISBN 0-582-24522-3.

Mech 5230: Computational Fluid Dynamics

Sem	2	Credits	10	Level	5	Tutor	Dr JL Summers	Pre-Requisites	Mech2270, 2280 or equivalent
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Form of teaching

30 x 1 hour lectures; 6 x 1 hour example classes

Form of assessment

Examination 1 x 3 hours (75%), extended assignment (25%).

Syllabus

Fundamentals

Introduction to linear algebra; finite differences and finite volumes; Taylor series and stability; conservation laws and properties; convective and diffusive processes.

Spectro-temporal methods

Domain decomposition; algebraic and Partial Differential Equation (PDE) grid solving techniques; unstructured meshes; error estimates and multigrids; time integration techniques and shock capturing methods.

Finite Element Method and Fluid Flow

The Ritz method; element equations from a variational principle; the Galerkin weighted residual method; natural and geometric boundary conditions; vorticity-streamfunction and primitive variable formulations; interpolation functions; completeness and compatibility.

Turbulence Modelling

The mixing length hypothesis; one equation models; the k- ϵ model; Reynolds stress modelling.

Applications

Incompressible and compressible flow; reacting and non-reacting flow.

Books

P J Roache "Fundamentals of Computational Fluid Dynamics" Hermosa Publishers

C Hirsch 1989 "Numerical Computation of Internal and External Flows", volume 1, "Fundamentals of Numerical Discretisation" (Wiley), Volume 2, "Computational Methods for Inviscid and Viscous Flow".

R T Fenner, Finite Element Methods for Engineers, Macmillan Press.

MD Gunzburger "Finite Element Methods for Viscous Flows. Academic Press

Mech 5245: Engine Tribology

Sem	2	Credits	10	Level	5	Tutor	Dr M Priest	Pre-Requisites	Equivalent of BEng (Hons) degree in engineering
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Form of teaching

27 hours Lectures, 3 hours tutorials and 3 hours seminars.

Form of assessment

One 2 hour examination (70%); 3 x case study assignments (30%)

Syllabus

Lubrication Regimes

- Boundary lubrication, mixed lubrication, elastohydrodynamic lubrication and hydrodynamic lubrication with regard to the operation of the major frictional components of the internal combustion engine.
- The Stribeck diagram.

Engine Bearings

- Background.
- Loading.
- Reynolds equation for dynamically loaded bearings.
- Mobility Method of design and its limitations.
- Advanced considerations.
- Materials.

Piston Assemblies

- Background. Kinematics.
- Piston ring geometry and mechanics.
- Lubrication analysis for a single ring and ring packs.
- Advanced considerations including the piston skirt and design.
- Materials.

Valve Train

- Background. Kinematics.
- Loading. Lubrication analysis.
- Design and operating characteristics.
- Materials.

Books

Engine Tribology, Elsevier Tribology Series, 26, Ed. C M Taylor, 1993.

Mech 5265: Combustion in Engines

Sem	2	Credits	10	Level	5	Tutor	Prof CGW Sheppard	Pre-Requisites	Mech2210, 2220, 2230, 2240, 2250 or appropriate 1 st degree
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Form of teaching

Lectures and examples classes (36 hours); Laboratory tests (2 x 3hrs)

Form of assessment

One 3 hour examination (50%), extended open examination paper/assignment (40%), laboratory report (10%)

Syllabus

The course is designed to give an understanding of the basic principles of combustion processes. These principles are established and applied to the various engine types commonly used in vehicle and aero propulsion as well as for land-based power generation. Extensive reference is made to the wide range of related combustion research projects under way in the Centre for Combustion and Energy Studies.

Introduction

Discussion of differing nature of combustion in various engine types, applications, environmental issues and performance considerations.

Combustion in Spark Ignition Engines

Thermochemical equilibrium otto cycle, instantaneous and empirical burn rate, CO and NO kinetics, heat transfer; Turbulent flame propagation, cycle modelling using u_t data, parametric study of effects of turbulence, mixture strength, ignition timing, throttling etc, on economy, emissions and performance; Gasoline components, reformulated fuels, autoignition chemistry, octane rating, autoignition prediction, end gas inhomogeneity, CFD modelling of modes of autoignition and pressure wave interaction, knock intensity; Lean burn, high EGR combustion, charge stratification, exhaust reactors and catalytic converters.

Compression Ignition Engine Combustion

Basic combustion process; physical and chemical ignition delay period; effects of air motion and turbulence; direct and indirect fuel injection; composition of diesel fuels, cetane rating, ignition improvers; influence of operating parameters on performance and emissions behaviour; polycyclic aromatic hydrocarbons and soot formation, modelling of CI engine combustion.

Gas Turbine Combustion

Performance criteria and basic combustor design; alternative fuel injection methods; modes and quantification of pressure loss and turbine entry profile; well stirred reactor and u_t concepts; combustion stability and ignition performance; wall cooling, reactor and CFD modelling of combustors; pollutant formation and emissions regulations; afterburners, ramjets and rocket propulsion. (Module led by Mech Eng with contributions from School of Chemistry).

Books

J.B. Heywood, "Internal Combustion Engine & Fundamentals". (McGraw Hill)

A. Lefebvre, "Gas Turbine Combustion". (Hemisphere).

Mech 5330: Competitive Product Design

Sem	1	Credits	10	Level	5	Tutor	Prof A de Pennington	Pre-Requisites	Equivalent of BEng (Hons) degree in engineering
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Form of teaching

6 hours lectures, 4 hours seminars, 7 hours design classes.

Form of assessment

One 2 hour examination (50%), 2 assignments (40%) and presentation (10%)

Syllabus

The design process:

How is the design process organised? The main steps: namely, clarification of the task, writing a design specification, generating concepts, selecting concepts and design evaluation will be discussed.

Management of product introduction.

Concurrent engineering:

What is concurrent engineering? The organisational issues including team building and co-location of personnel.

Design of manufacturability:

Designing products for ease of manufacture.

Design for assembly:

Designing products for ease of assembly.

Design for quality:

Designing quality into a product – ensuring that the product is what the customer wants.

Managing the product development process:

Managing design, project management and project planning tools.

Axiomatic Design:

Axioms providing a basis for design.

Lectures and course material available on the world wide web provide a foundation for the course. Case studies will be provided. A significant proportion of the course will be taken up by product redesign in teams using the tools and techniques introduced in the lectures and seminars.

Books

N.P. Suh: *The Principles of Design* (Oxford University Press, 1990)

Mech 5370: Exploiting Innovative Solutions

Sem	1	Credits	10	Level	1	Tutor	Dr BW Henson	Pre-Requisites	None
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Form of teaching

Lectures 11 x 1 hours; Seminars 4 hours Myers-Briggs workshop; Tutorials 6 x 15 minutes; 8 hours computing

Form of assessment

Written report on problem definition (less than 2000 words, 20%); Written report on solution methods and effects (less than 3500 words, 30%); Oral presentation addressing learning outcome of students' choosing in more depth (20%); Written report on theories evolution of technical systems (less than 3500 words, 30%).

Aims

This module aims to provide students with:

- a set of related concepts and definitions of what it means to be technologically innovative.
- a set of heuristic tools taken from the Theory of Inventive Problem Solving (TRIZ) and Unified Structured Inventive Thinking (USIT) to help generate innovative solutions.
- an exploration of current theories of when and how companies should innovate.

Learning Outcomes

On completion of this module students should be able to:

1. Describe and explain their preferred creative approach in terms of the Myers-Briggs inventory of styles.
2. Define inventiveness in terms of Altshuller's definition of 'contradictions'.
3. Write precise functional problem statements.
4. Describe and apply a variety of heuristic methods of engineering problem solving including closed world diagrams, the agents/particles method and solution methods based on the reconfiguration of function, objects and attributes in time and space.
5. Describe and use a computer-based database of physical effects.
6. Describe theories of evolution of technical systems in the context of the market and relate them to specific products.

Syllabus

Participants will have the opportunity to explore their preferred creative approach using the Myers-Briggs inventory of styles. Use of the inventory of styles will provide participants with a framework and language with which to describe their own and others preferences for innovation. Definitions of creativity, innovation and invention will be examined with emphasis on Althshuller's taxonomy of problems and Maimon and Horowitz's sufficient conditions for inventive solutions. The heuristic problem definition and solution methods known as Unified Structured Inventive Thinking (USIT) will be presented and applied. USIT provides a set of heuristic methods of engineering problem solving such as closed world diagrams, the agents/particles method and solution methods based on the reconfiguration of function, objects and attributes in time and space. The problem solving methods will be enhanced by consideration of physical effects and contradictions including use of a computer-based database of physical effects. Theories of the evolution of

technical systems from TRIZ and from s-curve analysis according to Christensen will be explored and applied to provide a real-world context for the module. Students will apply the theories of evolution of technical systems to a product of their own choosing during independent study. Information and methods will be presented through lecture material, reprints of journal papers and a web-based information pack.

Outline Timetable

An example module timetable is outlined below.

Week	Lectures	Deadlines
1	Module introduction and case studies.	
2	What is an invention?	
3	Closed-World method	
4	Particle method	
5	Qualitative change graphs	
6	Introduction to problem solving heuristics	Written report on problem definition (20%)
7	Time and space	
8	Solution methods	
9	Physical effects	Written report of application of solution methods (30%)
10	Evolution of technical systems	
11	Disruptive technologies	Oral presentation (20%)
12		
13		Written report on evolution of technical systems (30%)

Books

Semyon D. Savransky, "Engineering of Creativity: Introduction to TRIZ Methodology of Inventive Problem Solving", CRC Press; 2000, ISBN: 0849322553.

Oded Z Maimon and Roni Horowitz, "Sufficient Conditions for Inventive Solutions", *IEEE Transactions on Systems, Man and Cybernetics – Part C: Applications and Reviews*, 29, no 3, August 1999.

Clayton M Christensen, "Exploring the limits of the Technology S-Curve. Part 1: Component Technologies" and "Part 2. Architectural Technologies", *Production and Operations Management*, 1, no 4 (Fall 1992).

A Review of Creativity Principles Applied to Engineering Design. G Thompson and M Lordan, *Proceedings of the IMechE, Journal of Process Mechanical Engineering*, E1, Vol 213, 1999.

Mech 5410: Surface Engineering

Sem	1	Credits	10	Level	5	Tutor	Dr PA Dearnley	Pre-Requisites	None
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Form of teaching

Lectures 23 x 1 hour; Seminars 5 x 1 hour; Tutorials 3 x 1 hour; Practical classes 3 x 3 hrs

Form of assessment

Examination 2 hrs (60%); Laboratory reports (10%); 3 x Assignments (5%, 10% & 15%)

Syllabus

Unit 1 Introduction to surface engineering

Definition of surface engineering, diffusion techniques, deposition methods, high and low energy beam methods, surface engineering charts, elastic contact mechanics.

Unit 2 Mass transfer media

Solids, liquids, gases and plasmas, boronising - an example of thermochemical diffusion processing via four transfer media, gaseous boronising, plasma boronising, anatomy of a glow discharge plasma, industrial power supply features, pack and paste boronising, electrolytic and electroless boronising

Unit 3 The boronising response of materials

kinetics of diffusion processes, boronising response of steels, boronising of cemented carbides, applications, corrosion and wear response.

Unit 4 Physical vapour deposition technologies

ion plating, sputter deposition, reactive deposition, magnetron sputtering, general aspects of PVD (production sequence, advantages and disadvantages, microstructure), partial pressure control, summary of applications, duplex treatments.

Unit 5 Other ceramic coating methods

Plasma spraying - APS and VPS, process principles, component preparation, deposition rates, coating materials. Chemical vapour deposition - deposition rates, carbon control of the substrate, industrial CVD, typical procedures, advantages and disadvantages, use of CVD coatings in metal cutting, wear mechanisms.

Unit 6 Advanced aspects of nitriding

The effect of prior tempering temperature on nitriding response, the internal nitriding model, the concept of "diffuseness", nitriding stainless steels, gas nitriding and nitriding potential, the effect of white layer on wear resistance in rolling contact.

Unit 7 Wear mechanisms of surface engineered materials

Abrasion, oxidation, rolling contact and sliding wear behaviour of metals, ceramics, polymers and surface engineered materials.

Books

E. Tyrkiel and P A Dearnley (eds) "A Guide to Surface Engineering Terminology", The Institute of Materials, London, 1995.

ASM Handbook Volume 18, "Friction, Lubrication and Wear Technology", ASM International, Materials Park, OH, 1992.

Surface Engineering, A journal of "The Institute of Materials, London, since 1985.

I. M. Hutchings. "Tribology", Edward Arnold, 1992.

Mech 5510: Computational and Experimental Methods

Sem	1	Credits	10	Level	5	Tutor	Dr M Lawes	Pre-Requisites	None
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Form of teaching

Lectures given at 3 per week; Computer practical 1 per week from week 2; Computer assignment given before week 6. To be submitted in week 10.

Form of assessment

Computing assignment 50%; One 1.5 hour examination on Units 2 and 3: Answer 2 questions from 4 50%

Syllabus

Unit 1:	Computational Methods (12 Lectures, 10 x 1 1/2 hour practical classes)
1-2	Introduction to Fortran 77/90 programming.
3-4	Modules: modules and units, hierarchical structures, structure charts, functional specifications.
5-6	Syntax: syntactical axioms, expressions, assignments, constants and data formats.
7-8	Sub programs: functions and subroutines.
9-10	Decisions and loops: 'do' loops, logical expressions, conditional branching.
11-12	Arrays: arguments to procedures. Input and output formats.
Unit 2:	Experimental Methods (12 lectures)
13	Pressure transducers.
14	Temperature - thermocouples, compensation, optical pyrometry.
15	Hot wire anemometry.
16	Shadow and Schlieren photography.
17	Introduction to lasers. Laser Doppler Velocimetry..
18-20	Advanced laser diagnostics.
21-22	Mechanical measurements.
23-24	Automotive applications.
Unit 3:	Data acquisition and Signal Processing (8 lectures)
25-26	Computer-based data acquisition: Analogue interfacing basics, PC data acquisition boards, analogue to digital and

	digital to analogue conversion, digital i/o and counters/timers.
27-29	Frequency analysis: frequency content of signals, Fourier series, Fourier transform and frequency spectrum, discrete Fourier transform, sample rate and aliasing.
30-32	Digital filtering: transform function, first and second order, Bode plots, digital filters, difference equation, discretising continuous-time filters.

Books

Ellis T.M.R., 'Fortran 77 programming, 2 Ed', Addison Wesley.

Etter D.M., 'Fortran 77 with numerical methods for scientists and engineers', Benjamin Cummings.

Holman J.P. 'Experimental methods for engineers', McGraw Hill.

Mech 5821: Professional Project

Sem	1-3	Credits	40	Level	5	Tutor	Dr P C Brooks	Pre-Requisites	Bachelor degree in physical or engineering sciences. For MSc Medical and Life Sciences Engineering : An undergraduate degree in a physical, biological sciences or one of the cognate disciplines (min 2ii) or a medical degree or allied subject with a background in orthopaedics
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Form of teaching

Meetings with project supervisor at a mutually agreed frequency. Notionally 20 x 1 hour

Form of assessment

Preliminary report 5%; Presentation 5%; Poster 10%; Dissertation & viva 80%

Syllabus

The subject of the project will be drawn from the field of engineering implicit in the student's chosen programme of study. It will reflect an area of current interest. The project may be linked to industry and should be sufficiently broad to embrace more than one of the following: design, analysis, computation and experimentation. The principal deliverables are an oral presentation and full report on completion of the project.

Mech 5822: Technical Engineering Project

Sem	1-3	Credits	20	Level	5	Tutor	Dr P C Brooks	Pre-Requisites	Bachelor degree in physical or engineering sciences
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Form of teaching

Meetings with project supervisor at a mutually agreed frequency. Notionally 20 x 1 hour

Form of assessment

Preliminary report 5%; Presentation 5%; Poster 10%; Dissertation & viva 80%

Syllabus

The subject of the project will be drawn from the field of engineering implicit in the student's chosen programme of study. It will reflect an area of current interest. The project may be linked to industry and should focus on at least one of the following: design, analysis, computation and experimentation. The principal deliverables are an oral presentation and full report on completion of the project.