Liverpool John Moores University

Title:	Vehicle Dynamics and Propulsion Systems
Status:	Definitive
Code:	**6164ENG** (120110)
Version Start Date:	01-08-2019
Owning School/Faculty:	Maritime and Mechanical Engineering
Teaching School/Faculty:	Maritime and Mechanical Engineering

Team	Leader
Jack Mullett	Y
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Academic Level:	FHEQ6	**Credit Value:**	20	**Total Delivered Hours:**	74
Total Learning Hours:	200	**Private Study:**	126		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	48
Tutorial	24

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	Online AS1	Vehicle Dynamics - Online test using V.L.E.	15	
Test	Online AS2	Propulsion Systems - Online test using V.L.E.	15	
Exam	AS3	Examination	70	2

Aims

This module aims to provide Automotive engineers with specialist knowledge relating to the performance of road vehicles. It considers both the motion of the vehicle in response to applied load and the operation of conventional propulsion systems which use internal combustion systems.

Learning Outcomes

After completing the module the student should be able to:

1	Apply the principles of mechanics and dynamics to derive mathematical models describing the motion of road vehicles.
2	Analyse the performance of a road vehicle in traction, braking and cornering
3	Apply the gas laws and energy balance equations to analyse IC engine cycles and determine IC engine performance quantities from engine dynamometer test bed experimentation.
4	Analyse automotive cooling systems and compact heat exchangers by application of heat transfer equations, charts and tables.
5	Demonstrate familiarity with a range of pressure charging systems and undertake turbocharger matching calculations using analysis and charts.

Learning Outcomes of Assessments

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

Vehicle Dynamics-VLE test	1	2			
Propulsion Systems-VLE test	3	4	5		
Examination	1	2	3	4	5

Outline Syllabus

Part 1 – Vehicle Dynamics

This part of the module will provide an introduction to vehicle dynamics. It will follow the syllabus outlined in 'Fundamentals of Vehicle Dynamics' by Gillespie. Topics will include:

Introduction:

Coordinate systems
Motion variables
Forces

Acceleration:
Inertia Limited Acceleration
Power Limited Acceleration

Braking:
Constant Deceleration
Brake Proportioning

Road Load:

Aerodynamic
Rolling Resistance

Ride:
Excitation sources
Vehicle Ride Response

Cornering (Steady-State):
Low Speed
High Speed
Understeer gradient
Critical Speed

Suspensions:
Solid Axles
Independent Suspensions
Geometry (Independent Suspensions)
Roll Centres and Axis'
Active Suspensions

Steering:
Steering Linkages
Steering geometry
Steering Forces

Tires:
Construction
Traction
Cornering
Combines Slip

Part 2 – Propulsion Systems:

Air standard cycles (Otto, Diesel, dual and Atkinson cycles), fuel-air cycles, modelling of engine cycles, and comparison between ideal thermodynamic and actual mechanical IC engine cycles.

Performance criteria and parameters for IC engines (indicated, brake and frictional quantities, work, power, torque, mean effective pressures, efficiencies, air-fuel ratio, specific fuel consumption), IC engine testing (engine test bed and dynamometer) and associated instrumentation including in-cylinder pressure sensing.

Compact automotive heat exchanger types and designs, heat transfer mechanisms and heat exchanger analysis, log mean temperature difference (LMTD) and effectiveness (ε) – number of transfer units (NTU) methods, use of tables and charts, heat exchange prediction, fouling factors, and pressure loss calculations.

Pressure charging devices (superchargers, turbochargers) and effects on

thermodynamic performance. Turbochargers compressor and turbine characteristics, matching with IC engines, intercooling and waste gates

Learning Activities

Lectures, tutorials and demonstrations using software, or in a laboratory

Notes

The module will provide students with an in depth understanding of the dynamics and thermo-fluids systems within automotive vehicles.