

MODULE SPECIFICATION - ME3151 - Internal Combustion Engines & Vehicle Powertrain***Introduction***

This document outlines core information regarding a module. The information is regularly reviewed by the University and should be read in parallel with the relevant programme specification.

<i>Module Title</i>	Internal Combustion Engines & Vehicle Powertrain
<i>Module Reference Code</i>	ME3151
<i>Home Department</i>	Aeronautical and Mechanical Engineering
<i>Home School</i>	School of Engineering and Mathematical Sciences
<i>Module Credits</i>	15
<i>Module Level</i>	Level HE3

Module Rationale

Internal combustion engines fuelled by gasoline or diesel are the power plants of choice for road transportation and power generation for nearly 100 years. The automotive industry, with its numerous component suppliers, represents the largest industrial sector world-wide and is expected to remain strong for the foreseeable future. Understanding of engine operation requires good knowledge of basic thermodynamics, fluid mechanics and combustion, while knowledge of engine and vehicle design is highly complementary. New developments in gasoline and diesel engines include the use of the direct fuel injection concept which offers major advantages in fuel economy. Both engine types require sophisticated fuel injection and exhaust after-treatment systems, while the general trend is towards turbocharging and downsizing.

Educational Aims

To provide an understanding of the history of development of internal combustion engines.

To summarise aspects of thermodynamics (i.e. ideal cycles) of relevance to engine efficiency

To provide basic information about conventional/alternative/renewable transportation fuels and their properties

To provide a good understanding of in-cylinder fluid mechanics, fuel injection, fuel-air mixing, ignition and combustion

To describe the pollutant formation mechanisms and means of reducing exhaust emissions through improved combustion and use of catalysts and filters

To describe recent developments in spark-ignition and compression-ignition engines

Outline Content

Engine types and history of engine developments
Ideal air cycles; advantages and limitations
Engine terminology and basic equations
Automotive fuels and their properties
Induction system; port fuel injection and in-cylinder flow
Fuel/air mixture preparation and ignition
Flame propagation and combustion characteristics
Knock intensity/frequency and implications for chamber design
Pollutant formation: NO_x, UHC, CO and soot
Exhaust after treatment systems
Exhaust gas recirculation for NO_x reduction
Advanced combustion concepts: direct-injection engines
Application of laser techniques and CFD to gasoline engines
Turbocharging and supercharging
Transmission systems and gearbox
Kinematics of rotating shafts and flywheels

Indicative Reading List

Internal Combustion Engine Fundamentals-J.B. Heywood-McGraw Hill-1988

Introduction to Internal Combustion Engines- R.Stone- MacMillan Education Ltd.-2nd edition-1992Fundamentals of
Vehicle Dynamics-T.Gillespie-SAE-1999

Teaching, Learning and Assessment

Learning and Teaching Methods

Lectures, coursework and tutorials

Assessment Methods

Lectures, coursework and tutorials
 KU
 Coursework and written examination
 SS
 Coursework and written examination
 TR
 Coursework and written examination
 VA
 Coursework and written examination

CI: Cognitive and Intellectual
KU: Knowledge and Understanding
SS: Subject Specific

TR: Transferable
VA: Values and Attitudes

MODULE TEACHING PATTERN

<i>Teaching Component</i>	<i>Type</i>	<i>Contact Hours</i>	<i>Self Directed Study Hours</i>	<i>Total Student Learning Hours</i>
Theory and applications	Lecture	36	76	112
Problem solving	Tutorial	8	30	38
Totals		44	106	150

LEARNING OUTCOMES

On successful completion of this module, a student will be expected to be able to:

Cognitive/Intellectual Skills

Identify strengths and weaknesses of spark-ignition and compression-ignition engines

Evaluate the thermodynamic/thermal/volumetric efficiency of engines

Perform quick calculations of the torque/power output and fuel efficiency of engines

Evaluate different engine designs in terms of global and local exhaust emissions

Evaluate efficiency of exhaust after-treatment systems

Knowledge and Understanding

Understand the various engine types and history of their development

Understand the mechanisms of power/torque transfer to the crankshaft

Understand the fundamentals of manual and automatic transmission systems

Evaluate the properties of present and future automotive fuels

Analyse the thermodynamic efficiency of gasoline and diesel engines

Evaluate the flow characteristics of various engine designs

Evaluate the efficiency of the fuel/air mixing process and combustion

Estimate the pollutant formation in gasoline and diesel engines

Calculate the torque/power output, thermal and fuel efficiency, volumetric efficiency, air/fuel ratio, fuel consumption and bore-to-stroke ratio

Evaluate the role of piston-ring lubrication in friction, wear and exhaust emissions

Subject Specific Skills

Analyse various engine designs

Evaluate the applicability of laser-based diagnostic techniques to solution of engine problems

Understand the role of computational fluid dynamics in engine design.

Understand the role of transmission systems and the operation of gearbox

Appreciate balancing issues in engines

Understand the kinematics of rotating shafts and wheels

Transferable Skills

Communicate with engineers in industry using common terminology

Work in teams in solving complex engine problems

Values and Attitudes

Evaluate the social advantages and benefits of road transportation

Evaluate the environmental impact of road transportation

Evaluate the role of automotive industry as employer and as contributor to wealth creation

Appreciate the role of engineers in society and governance

MODULE ASSESSMENT

<i>Assessment Component</i>	<i>Assessment Type</i>	<i>Weighting</i>	<i>Minimum</i>	<i>Pass/Fail</i>
Coursework	Coursework	30	40	N
Examination	Exam (Unseen)	70	35	N

MODULE RELATIONSHIPS

Pre-requisite Relationships

Co-requisite Relationships

Non-requisite Relationships

Module Pass Requirements

Module Mark 40

Module Pass Requirements

In order to pass the module and acquire the associated credit, a student must complete or be exempted from the assessment component(s) and achieve an aggregate Module Mark of 40%.

The Module Mark shall be calculated from the Coursework weighted at 30% with a minimum mark of 40% and Examination weighted at 70% with a minimum mark of 35%.