Faculty	**Ingegneria**
Master	**Mechanical Engineering**
Curriculum	**Energy**
Year/Semester	**1/I**

Course Title	**Internal combustion engines**
ID Course Code	**56851**
Course Credits (CFU)	**6**
Scientific-Disciplinary Sector	**ING-IND/08**
Course Type	**mono-disciplinary course**
Lecturer-in-charge	**CAPOBIANCO Massimo**

Learning Outcomes:

The aim of the course is to provide an adequate qualification in the field of reciprocating Internal Combustion Engines (ICE), deepening some of the most important topics related to different engine applications.

Course Organisation Details

A. Lectures

- *General aspects* – Introduction and historical perspective, ICE classifications, engine components, nomenclature and symbols, operational parameters – Ideal and real operation of 2 and 4 stroke engines – Indicated diagrams, indicated and brake mean effective pressure – Engine power correlations – ICE energy balance – Determination of multicylinder engine torque – Fuel supply circuits of spark ignition (SI) and diesel engines.
- *Thermodynamic processes in ICE* – Reference thermodynamic cycles for SI and diesel engines – Ideal Beau de Rochas, Diesel and Sabathè cycle: efficiency calculation – General aspects related to fuel-air cycles – Calculation of the fuel-air cycle for spark ignition and compression ignition engines – Real engine cycles: analysis of loss contributions.
- *Engine part load operation and control* – Control engine parameters – Constant speed and constant load curves, engine performance maps – Part load operation of spark ignition and diesel engines – Analysis of engine performance and fuel consumption at different speed and load levels – Road vehicle performance simulation..
- *Supercharging and turbocharging* – Engine-compressor matching in mechanical supercharging and turbocharging - Determination of the operating condition of an exhaust turbocharger – Constant pressure and pulse turbocharging – Efficiency, transient response and torque characteristics of supercharged and turbocharged engines – Turbocharger control systems (waste-gate valve, variable geometry turbines) – Design features of exhaust turbochargers.
- *ICE pollutant emissions* – Normal and abnormal combustion processes in SI engines – Combustion in compression ignition engines – Pollutant formation processes – Influence of design and operational engine parameters on pollutant emissions – Emission control systems and aftertreatment devices (exhaust gas recirculation, catalytic converters, particulate filters) – Normalized test procedures for vehicle emissions determination, European emission limits.

B. Practice

- Dynamometer test bench measurements of an automotive engine performance, fuel consumption and exhaust emissions.
- Experimental definition of the performance maps of an automotive turbocharger.

Assessment	hours
Lectures	**55.0**
Practice	**10.0**
Laboratory	**0.0**
Integrative activities	**0.0**

References

- M. Capobianco - “Motori a combustione interna” – Notes to the course (in Italian) – www.iceg.unige.it.
- A. Beccari, C. Caputo - "Motori termici volumetrici" - UTET.
- G. Ferrari - "Motori a combustione interna" - Il Capitello.
- C.F. Taylor - "The Internal Combustion Engine in Theory and Practice" - MIT Press.
- J.B. Heywood - "Internal Combustion Engine Fundamentals" - Mc. Grow-Hill.
- K. Zinner - "Supercharging of Internal Combustion Engines" - Springer Verlag.
- N. Watson, M.S. Janota – “Turbocharging the Internal Combustion Engine” – MacMillan Press Ltd.

Organization and examinations

Examination: written and oral test.

Pre-requisites

Basic thermodynamic and fluid dynamics knowledge.