



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: October 2019

Module Number: ME 5214

Module Name: Advanced Automobile Engineering

[Three Hours]

[Answer all questions, each question carries ten marks]

All assumptions must be stated clearly. Sketches and diagrams are to be provided where required. Symbols stated herein denote standard parameters.

-
- Q1 a) With respect to the automobile engine emissions, what are the primary pollutants released to the atmosphere? What are the origins of these primary pollutants?
[3.0 Marks]
- b) Briefly explain the mechanism of pollution formation in an automobile engine. You may use chemical formulae for the explanation.
[3.0 Marks]
- c) What is a "Three-way Converter"? Explain clearly how it is used to convert the pollutants emitted from an internal combustion engine.
[4.0 Marks]
- Q2 a) Define the term "Fuel". What are the principal constituents of a fuel?
[2.0 Marks]
- b) Though there are many requirements of a "good" fuel, there are some important requirements for a fuel to be used in internal combustion engines. List out those important requirements and briefly explain.
[3.0 Marks]
- c) What do you understand by "detonation" in an IC engine? What are the factors influencing "detonation"?
[2.0 Marks]
- d) List out four (04) main effects of "detonation".
[2.0 Marks]
- e) Give two (02) different methods used for the prevention of "detonation" in an IC engine.
[1.0 Mark]
- Q3 a) Electric vehicles and Hybrid electric vehicle, in substitution of internal combustion engine (ICE) vehicles, are a part of the solution to problems such as urban air pollution, fossil fuel depletion and global warming. As an engineer, do you think, electric vehicles and hybrid electric vehicle are eco-friendly? Discuss this under three main subtopics with suitable details.
[4.0 Marks]

- b) Suppose you (as an engineer) are asked to select a vehicle to purchase for a colleague, how do you explain the short term and long term pros and cons of IC engine powered vehicle, electric vehicle and hybrid electric vehicle according to the requirements of the friend? Discuss this situation with suitable details under four main categories at least.

[3.0 Marks]

- c) With neatly drawn diagrams discuss the three (03) available architectures of hybrid electric vehicles according to the method the energy sources are arranged.

[3.0 Marks]

- Q4 a) An electric vehicle, also called an EVs, uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels or an electric generator to convert fuel to electricity and regenerative braking system to eliminate the waste of energy.

- i) Discuss the six types of electric vehicle available in today with the aid of suitable details and sketches.

[3.0 Marks]

- ii) Discuss the regenerative braking system with the aid of suitable details and sketches.

[2.0 Marks]

- b) What are the six possible EV configurations of clutch, differential, fixed gearing, gear box and electric motor? Discuss them briefly with the aid of suitable details and sketches.

[2.0 Marks]

- c) Discuss the behavior of torque according to the gears in Figure Q4 (c) with the aid of suitable key words.

[3.0 Marks]

- Q5 a) A hybrid drive train of Hybrid Electric Vehicles (HEV) can supply its power to the load by a selective power train. There are many available patterns of operation of two power trains (two power sources) to meet the load requirement. Discuss all possible patterns briefly with the aid of suitable details and sketches.

[3.0 Marks]

- b) HEVs can be classified mainly into four architectures. Discuss all four architectures briefly with the aid of suitable details and sketches. Electrical, hydraulic and mechanical links must be clearly mentioned with legend.

[3.0 Marks]

- c) A drive Train configuration with torque coupling with two shafts is given in Figure Q5 (c). According to the figure, develop a graph for variations of speed and tractive effort if the vehicle have,

- i) 1 gear of transmission.1 and 1 gear of transmission.2 for $x= 4$
ii) 3 gears of transmission.1 and 1 gear of transmission.2 for $x= 4$
iii) 1 gear of transmission.1 and 3 gears of transmission.2 for $x= 2$

Where, x is motor speed ratio and discuss each briefly.

[4.0 Marks]

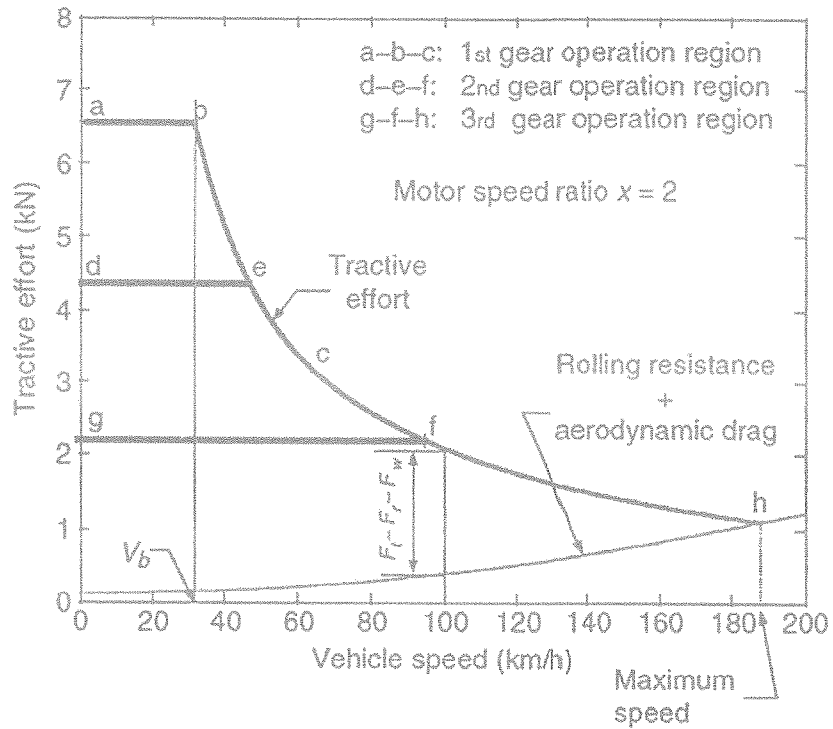


Figure Q4 (c) Diagram of vehicle speed vs. tractive effort

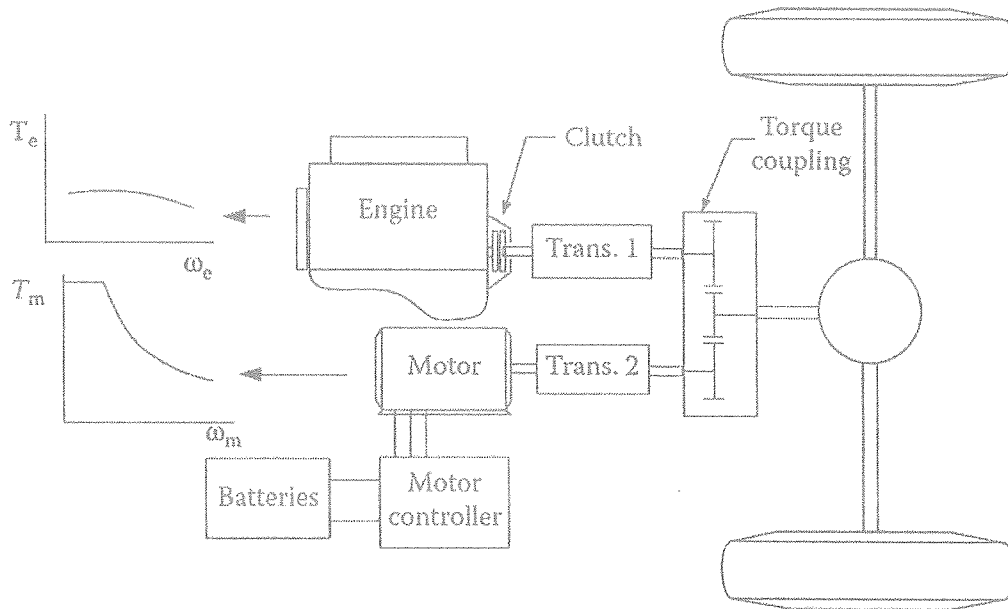


Figure Q5 (c) Drive Train Configurations with Torque Coupling with two shafts