THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF TECHNOLOGY HONOURS IN ENGINEERING
FINAL EXAMINATION
MEX 6331/MEX6231- AUTOMOBILE ENGINEERING
DATE : 8th December 2016
TIME : 09:30 HRS to 12:30 HRS
DURATION : Three hours

Instructions. : This question paper consists of seven (07) questions. You are required to answer any five (05) questions. All questions carry equal marks.

Question 01

The following parameters are given for a typical gasoline engine

- Volumetric efficiency – 72%
- Mechanical efficiency – 82%
- Calorific value of gasoline – 42 MJ/kg
- Excess air factor – 10%
- Pressure of the mixture at the end of suction stroke – 8.24×10^4 N/m^2.
- Temperature of the mixture at the end of suction stroke – 333K.
- Gas constant for air – 0.287 kJ/kgK
- Stoitiometric air/fuel ratio – 14.5:1

Find the cylinder dimensions for a four cylinder four stroke engine if the engine is to develop 120 kW at 3600 rev/min. Assume that the S/B = 1.25, thermal efficiency is 24% and densitiy of petrol vapour in the mixture is twice that of air.

Question 02

(a) Using a neat sketch, show the variation of HC, CO and NO_x emission concentrations with air/fuel ratio for a non emission controlled automobile gasoline engine.

(b) On the same graph show the following

(i) Region for maximum fuel economy
(ii) Region for lowest harmful emission concentrations
(iii) How this behaviour would change by fixing a three way catalytic converter to the exhaust system of the engine.

(c) Briefly explain why a modern electronically controlled engine may stall immediately after discontinuation of power supply to the control module.

Question 03

(a) Starting from first principles, show that the air standard efficiency of an engine, working on the Otto cycle is given by

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

(b) A four cylinder four-stroke engine was tested for two minutes on a rope brake dynamomenter at a speed of 5600 rev/min. A total of 560 g of fuel was consumed. The radius of the brake pulley was 340 mm. The difference in tension on either side of the brake pulley was 400 N.

You may assume that:

- the bore diameter is 180 mm,
- stroke is 200 mm
- clearance volume is 10% of total swept volume
- mechanical efficiency is 82%,
- calorific value of fuel is 45 MJ/kg
- ratio of specific heats is 1.4

Determine the following.

i. compression ratio
ii. Indicated power
iii. Brake power
iv. Indicate mean effective pressure
v. Indicated efficiency
vi. Otto cycle efficiency
vii. Specific fuel consumption

Question 04

(a) Briefly explain how accidentally reverse selection during forward drive is prevented in modern automatic gear systems.

(a) Modern transmission systems are designed to adapt automatically to driving styles and environmental conditions (adaptive controlling). Briefly explain how the systems adapt to following conditions.

i. Stop and Go Driving
ii. Curve Recognition
iii. Winter Drive Program
iv. Cruise Control Program
v. Hill Recognition Program

(b) Figure Q4 shows five time multi point injection pattern for a typical commonrail diesel engine. Briefly explain the significance of each point

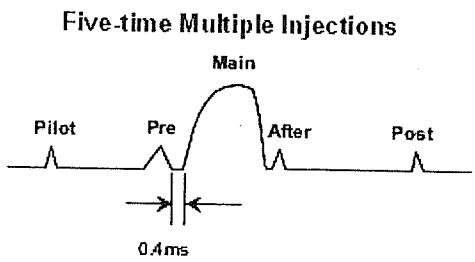


Figure Q4

(c) Briefly explain how the basic injection quantity is calculated in a common rail diesel fuel injection system

Question 05

(a) Main components of an ABS system are shown in Figure Q5(a). Explain the operation of all major sensors and the ABS modulator involved in the operation of the system.

(b) Explain the operating principle of a traction control system and how the ABS system can be advanced to a traction control system.

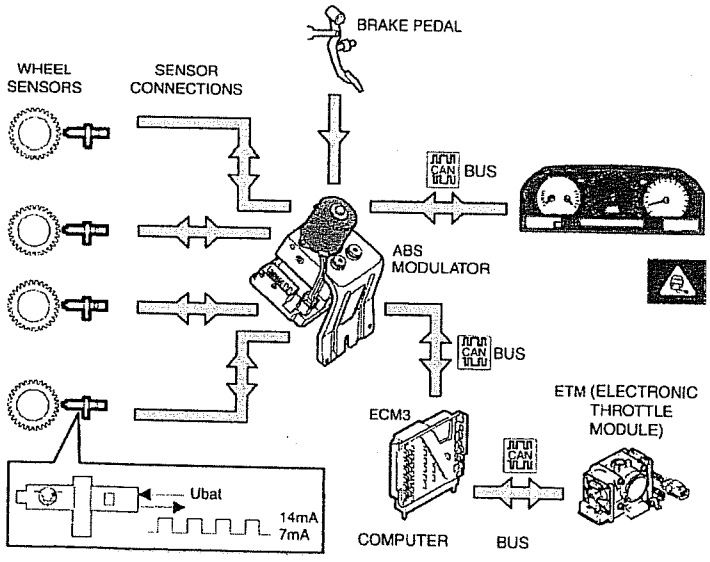
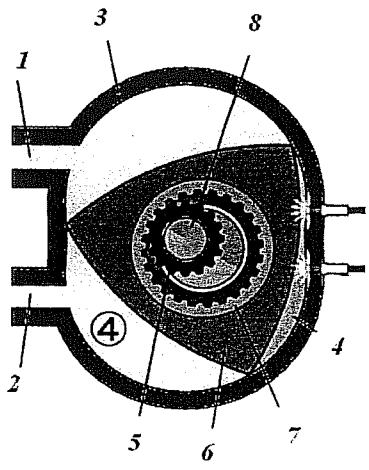


Figure Q5(a)

(c) A Typical Wankel engine is shown in Figure Q5(b). Using additional sketches, explain its operating principle.



1. Engine inlet
2. Exhaust outlet
3. Housing
4. Combustion chambers
5. Stationary gear
6. Rotor
7. Internal gear
8. Eccentric shaft
9. Spark plugs

Figure Q5(b)

(d) Three main combustion systems namely: spray-guided, wall-guided and air-guided systems are used in different stratified engines, to form an ignitable mixture near spark plug at the instant of ignition. Briefly explain how the mixture is formed in each system.

Question 06

Figure Q6 shows an epicyclic gear box. The pinions S_1 and S_2 are driven directly from the engine by the shaft B and gear through pinions P_1 and P_2, with the annular wheels A_1 and A_2. These annular wheels may be locked in turn to give two speeds to the driven shaft C. The first speed occurs when A_1 is locked and the second speed occurs when A_2 is locked. The pinion P_2 rotates freely on a pin carried by A_1 and P_1 rotates freely on a pin carried by the arm which is keyed to the driven shaft C.

Assuming that the number of teeth on A_1 to be equal to that on A_2 and that the number of teeth on S_1 and S_2 to be equal, find

i. the ratio of the number of teeth on A_1 to the number of teeth on S_1 when the second speed is 1.75 times the first speed and in the same direction.
ii. first and second gear ratio
iii. first and second speeds for this ratio when the engine speed is 3400 rev/min.

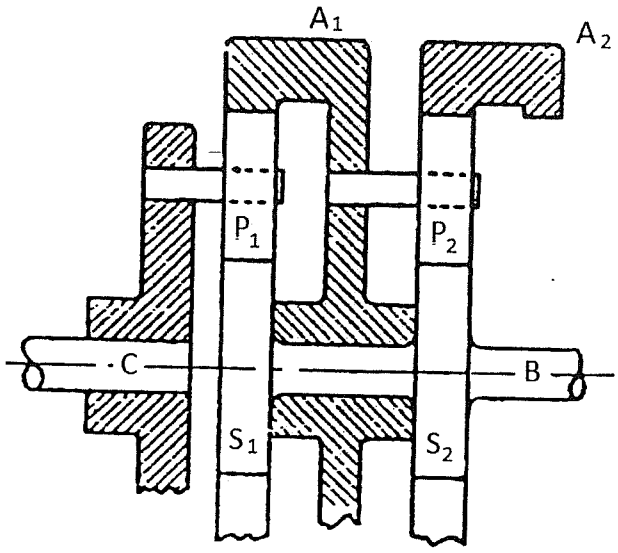


Figure. Q6

Question 07

(a) A schematic diagram of a typical fuel cell is shown in Figure Q7. Briefly explain the operation of the fuel cell.

(b) Draw a schematic diagram for a fuel cell hybrid power train of a vehicle and identify all major components.

(c) Discuss future perspectives of fuel cell vehicles as an alternative to conventional fossil fuel based transport system in Sri Lanka.

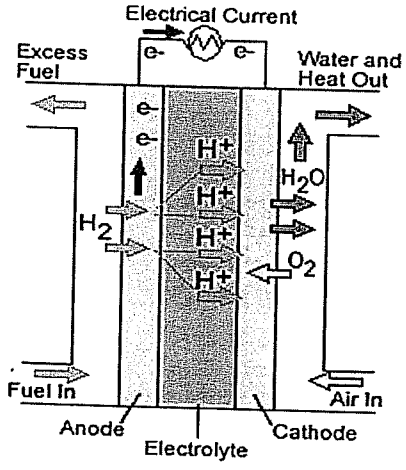


Figure Q7

(d) In GDI engines there are two basic charge modes employed; homogeneous charge and stratified charge. Briefly explain the key differences of both charge modes and their functions.

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