THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
BACHELOR OF TECHNOLOGY (MECHANICAL) – LEVEL 6
FINAL EXAMINATION 2008/2009
MEX6331 AUTOMOBILE ENGINEERING **023**
DATE : 31st March 2009
TIME : 0930 hrs to 1230 hrs
DURATION : Three hours

Instructions. : This question paper consists of two parts. Part A consists of two (02) questions and part B consists of six (06) questions. You are required to answer only five (05) questions selecting at least one (01) question from part A. All questions carry equal marks.

PART A

Question 01

Following observations were made with respect to a six cylinder, four stroke engine that develops 66 kW at 4200 rev/min and having a thermal efficiency of 22% under the test conditions.

Volumetric efficiency = 80 %
Mechanical efficiency = 82%
Excess air supplied = 25% higher than theoretically needed
Pressure of the air fuel mixture at the end of suction stroke – 8.24×10^4 N/m^2
Temperature of the air fuel mixture at the end of suction stroke – 330 K

Assuming that the petrol vapour has twice the density of air, the universal gas constant is 287.14 J/kg K and the calorific value of petrol is 46,000 kJ/kg, determine the following.

(i) Indicated power
(ii) Indicated thermal efficiency
(iii) Weight of fuel consumed per minute
(iv) Weight of air theoretically required
(v) Volume of air supplied per minute
(vi) Volume of petrol vapour present in the mixture per minute
(vii) Total swept volume (the volume needed to contain the air and petrol vapour in intake conditions)
(viii) The cylinder dimensions assuming a ratio of stroke to cylinder bore diameter of 1.25

Question 2

a) A schematic diagram of a common rail diesel fuel injection system is shown in the Figure Q2. Explain the operation of the system referring the figure.
b) A B C D E and F indicate sensors that are employed in addition to the air mass flow sensor. List out sensors that are indicated by A B C D E and F

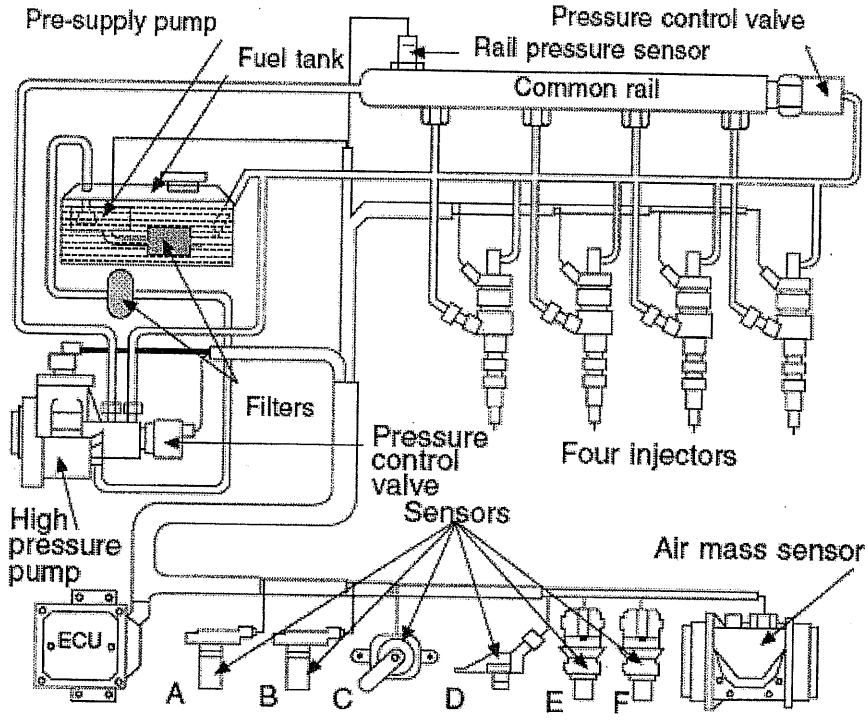


Figure Q2

PART B

Question 3

a) A gasoline fuel injection system is shown in the figure Q3. Explain the operation of fuel injection and fuel ignition system referring to the figure.
b) The lambda closed loop system is a method that has been adopted in gasoline fuel injection systems to meet stringent emission regulations. Explain the operating principle of the lambda closed loop system.

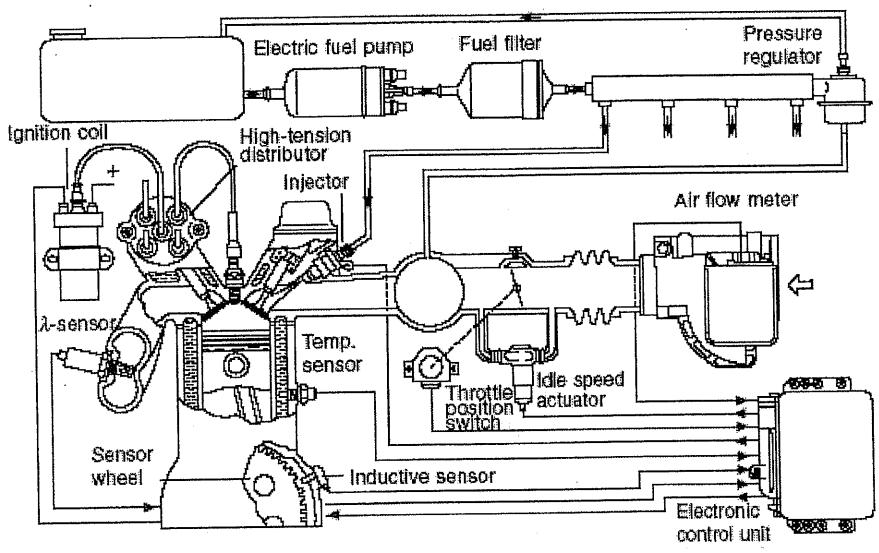


Figure Q3

Question 4

a) The layout of a four-speed automatic gear box is shown in the figure Q4. Explain the operation of the first gear and the reverse gear referring the table given below.

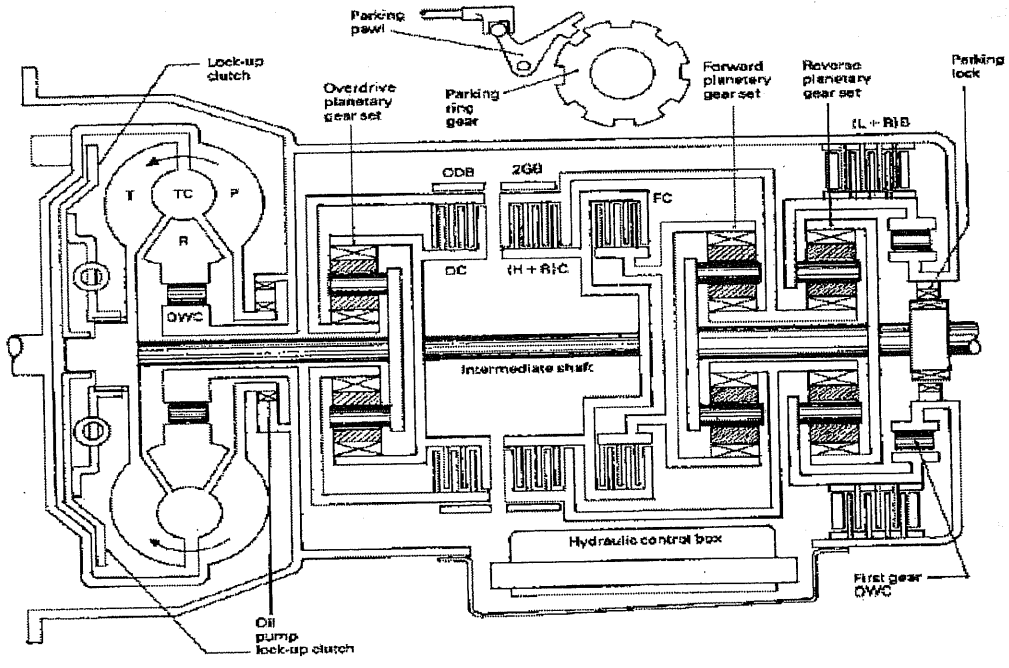


Figure Q4

Range	Drive clutch DC	High and reverse clutch (H + R) C	Second gear band brake 2GB	Forward clutch FC	Overdrive brake ODB	Low and reverse brake (L + R)B	One way clutch OWC	Ratio
P and N	–	–	–	–	–	–	–	–
First D	Applied	–	–	Applied	–	–	Applied	2.4:1
Second D	Applied	–	Applied	Applied	–	Applied	–	1.37:1
Third D	Applied	Applied	–	Applied	–	–	–	1:1
Fourth D	–	Applied	–	Applied	Applied	–	–	0.7:1
Reverse R	Applied	Applied	–	–	–	Applied	–	2.83:1

b) A compound epicyclic gear is shown in the figure Q4 (b). Number of teeth for gears A, B, C, D and E are given as N_A= 30, N_B= 20, N_C= 30, N_D= 70, N_E= 80. A rotates at 1500 RPM clockwise and E rotates at 900 RPM anticlockwise. Determine the speed and direction of rotation of ring gear D and shaft F

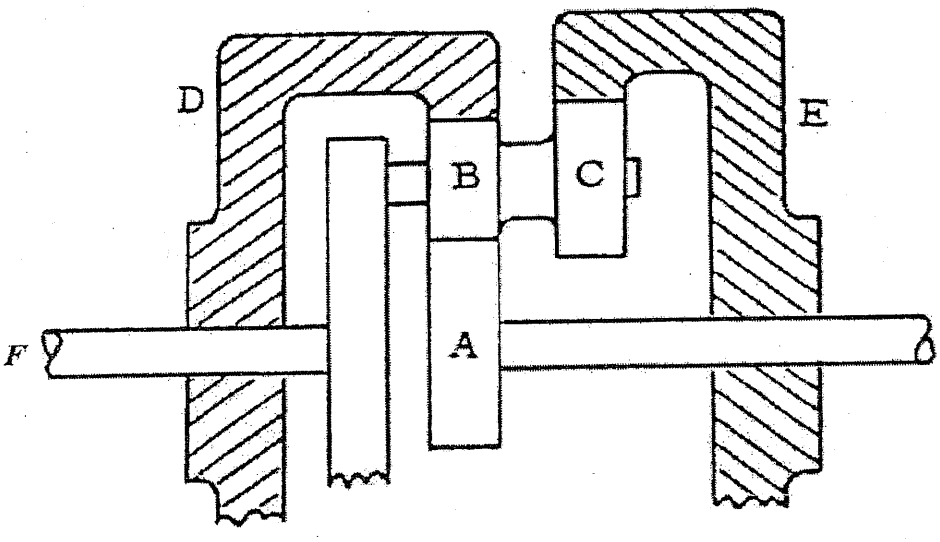
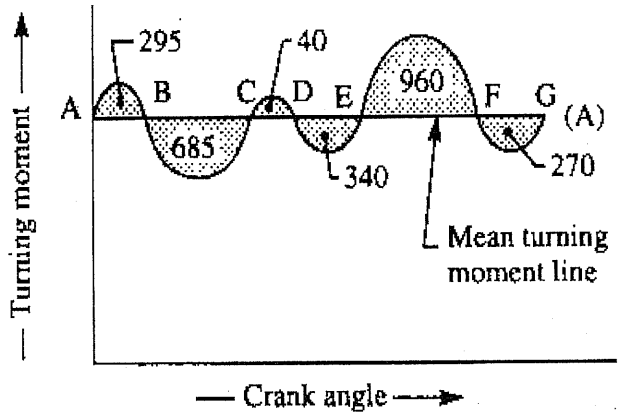


Figure Q4(b)

Question 5

The turning moment diagram for an engine is drawn to following scales: Turning moment, 1 mm =5 Nm; Crank angle, I mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below mean turning moment line, taken in order are 295, 685, 40, 340, 960, 270 mm^2. Determine the moment of inertia of the flywheel if a fluctuation of speed of ± 1%, is to be maintained when the engine is running at 2400 rev/min.



Question 6

The full throttle performance (Power, Torque and Specific Fuel Consumption) of an engine fitted to a vehicle is represented in the figure Q6. The transmission system of the same vehicle consists of a gear box having five forward speeds. The vehicle speed variation with the engine speed for each gear is also presented in the same figure.

a) Using a rough sketch, show the optimum gear changing positions in terms of acceleration and fuel economy to reach a final speed of 120 km/h.
b) Show the variation of available tractive effort for each gear ratio using a graph of tractive effort vs linear speed of the vehicle.

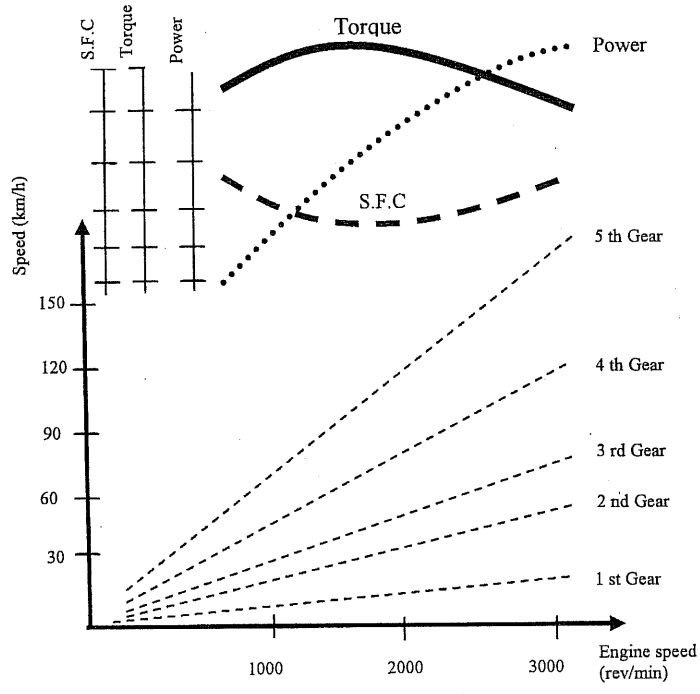


Figure Q6

Question 7

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 five minutes in a rope brake dynamometer at a speed of 1800 rev/min. A total of 1.2 kg of fuel was consumed. The diameter of the brake pulley was 300 mm. The difference in tension on either side of the brake pulley was 650 N. If the mechanical efficiency of the engine is 80 % and bore diameter is 108 mm and stroke is 122 mm.

calculate the following.

(i) Brake thermal efficiency.
(ii) Indicated thermal efficiency.
(iii)Mean effective Pressure.
(iv)Specific fuel consumption.
(Take the calorific value of fuel as 42000 kJ/kg)

Question 8

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) Explain whether the best way of controlling toxic emissions is by controlling the engine performance parameters or by using exhaust after treatment methods such as catalytic converters.

END.