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**THE OPEN UNIVERSITY OF SRI LANKA**
**FACULTY OF ENGINEERING TECHNOLOGY**
**BACHELOR OF TECHNOLOGY (MECHANICAL – LEVEL 6)**
**FINAL EXAMINATION 2010/2011**
**MEX6331 AUTOMOBILE ENGINEERING**
**DATE** : 23rd March 2011
**TIME** :**1400 hrs to 1700 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.**

(a) Starting from fundamentals show that the velocity of a piston in a reciprocating engine is given by $V_p = \omega r\left(\sin\theta + \frac{\sin 2\theta}{2n}\right)$

where,
Vp – velocity of the piston
ω – angular velocity of rotation of the crank shaft
θ – crank angle
n – the ratio of connecting rod length to crank radius

(b) for an engine rotating at 1800 rev/min and having a crank radius of 50 mm and a connecting rod length of 150 mm, determine the maximum velocity of the piston and the corresponding crank angle.

**Question 02.**

The following parameters are given for a typical gasoline engine

- Volumetric efficiency – 75%
- Mechanical efficiency – 82%
- Calorific value of gasoline – 45 MJ/kg
- Excess air factor – 25%
- Pressure of the mixture at the end of suction stroke – $8.24 \times 10^4$ 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 six cylinder fourstroke engine if the engine is to develop 75 kW at 3600 rev/min. Assume that the S/B = 1.25, thermal efficiency is 20%, densitiy of petrol vapour in the mixture is twice that of air.

## Part B

**Question 03.**

(a) Assuming that gasoline consists of of 100% Octane, show that the theoretical air/ fuel ratio for gasoline is 15:1 (assume that air contain 23% of Oxygen by mass).

(b) A typical governor of an inline type diesel fuel injection pump is shown in the Figure Q3. Explain its operating principle in following modes.

i. Idle speed
ii. Full load
iii. Maximum speed

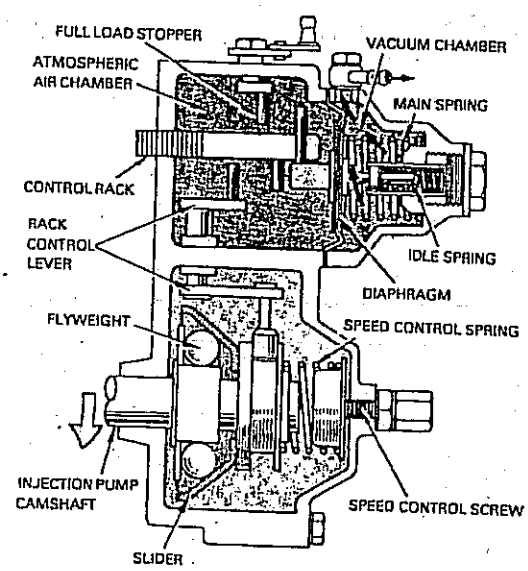



Figure Q3

**Question 04**

(a) Using a rough sketch explain the operating principle of an Anti Lock Braking system.
(b) Explain the operating principle of a traction control system
(c) Briefly explain how an ABS system can be extended to perform the functions of a traction control system.

**Question 05**

(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.

**Question 06**

(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 three minutes in a rope brake dynamometer at a speed of 1600 rev/min. A total of 0.714 kg of fuel was consumed. The radius of the brake pulley was 450 mm. The difference in tension on either side of the brake pulley was 435 N. Assuming the bore diameter to be 108 mm, stroke 122 mm and mechanical efficiency 82%,

calculate the following. ( Take the calorific value of fuel as 42000 kJ/kg)

(i) Brake thermal efficiency.
(ii) Indicated thermal efficiency.
(iii)Mean effective Pressure.
(iv)Specific fuel consumption.

**Question 07**

Part of a tpical automatic gear train of an automobile is shown in the figure Q7.

(a) Determine the number of teth on each gear so that the speed ratio between the sun wheel and the carrier is 1:4 and the minimum number of teeth on any gear is 14.
(b) If the driving torque on the sun wheel is 150 Nm, calculate the torque on C and the torque reqired to keep the internal gear stationary.

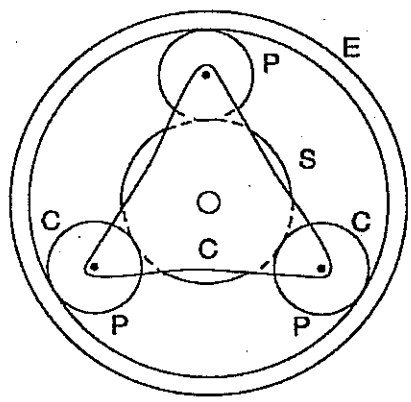



Figure Q7

**Question 08**

(a) It is essential to inject the precise quantity of fuel in gasoline fuel injection systems in order to maximize the fuel efficiency and minimize the harmful emissions. Using an appropriate schematic diagram, explain briefly the function of sensors and actuators employed in such systems.
(b) Explain the operation of lambda closed loop operating in such systems

**END.**