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The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: Automobile Engineering - DMX6531/MEX6231
Academic Year	: 2017/18
Date	: 09th February 2019
Time	:09:30-12:30
Duration	: 3 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

During a rope brake dynamometer test on a four stroke four cylinder engine running on gasoline, the following observatons were made

no of cylinders	-4
calorific value of the fuel	-45000kJ/kg
fuel consumption	-7.6 l/h
density of fuel	-0.82kg/l
speed of the engine	-2600rev/min
effective pulley diameter	-0.25m
dead weight on brake	-800N
spring balance reading	-40N
rate of flow of jacket cooling water	-200kg/h
temperature rise of jacket cooling water	-30C
IMEP	-800000N/m2
cylinder bore dia	-110mm
poston stroke length	-120mm
specific heat capacity of water	-4.18kJ/kg K

Determine

a) Mechanical Efficiency
b) Indicated Thermal Efficiency
c) Brake Thermal Efficiency
d) Energy Balance for the Engine

Question 02

(a) A six cylinder gasoline engine has the following parameters

- Volumetric efficiency – 80%
- Mechanical efficiency – 70%
- Calorific value of gasoline – 42 MJ/kg
- Thermal efficiency -24%
- Excess air factor – 15%
- 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
- Bore diameter -116 mm
- Stroke -145 mm

i Determine the power developed by the engine when running at 3600 rev/min

ii If the engine has five (05) cylinders instead of six (06), what is the power developed by the engine? Compare the power reduction of the former with respect to the latter.

Iii Compare and contrast the power developed by the five cylinder engine at 4200 rev/min with that developed in the case of a six cylilnder engine under the conditions given in (i).

You may neglect the volume of petrol vapour occupied in the air-fuel mixture.

(b) 'Modern transmission systems are designed to adapt automatically to driving styles and environmental conditions (adaptive controlling).' Briefly explain how the systems adapt when the following programmes are executed.

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

Question 03

(a) Starting from first principles, show that the Air Standard Efficiency of an engine, working on the Otto cycle is given by

$\eta = 1 - \frac{1}{r^{\gamma-1}}$, where r is the compression ratio and $^{\gamma}$is the isentropic index.

(b) A four cylinder four-stroke engine was tested for two minutes in 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 to be 180 mm, stroke 200 mm
clearance volume is 10% of total swept volume
mechanical efficiency 82%,
calorific value of fuel is 45 MJ/kg
ratio of specific heats 1.4

Determine the following.

a) Compression ratio
b) Indicated power
c) Brake power
d) Indicate mean effective pressure
e) Indicated efficiency
f) Air-Standed Otto cycle efficiency
g) Specific fuel consumption

Question 04

a) Starting from fundamentals show that the maximum velocity of a piston is given by

$$v_p = \omega r\left(\sin\theta + \frac{\sin 2\theta}{2n}\right)$$

Where

- Vp – velocity of the piston
- ω – speed of the engine rad/sec
- r - radius of the connecting rod
- n – rartio of length of connecting rod to crank radiuis
- θ – crank angle from top dead centre

b) If the crank radius and the length of connecting rod are 104 mm and 240 mm long respectively and the crank rotates ata constant speed of 2000 rpm determine

i. the crank angle at which the maximum velocity occurs
ii. maximum velocity of piston

Question 05

a) The variation of HC, CO and NOx emissions extracted from an internal combustion engine is shown in Figure Q5.
Briefly explain what is NOx

b) When the engine is running with a lean mixture, while HC and CO emissions have been reduced, the NOx concentration has increased and again reduced. Explain why NOx concentration is increasing in this region.

c) Variable valve timing is generally applied in one of the two ways:
- The point of inlet valve opening varied, and the closure is fixed
- Both are fixed relative to each other but their timing (i.e. the inlet phase) advanced or retarded simultaneously.

Describe the operating principle of both systems using two separate graphs of valve lift vs crankshaft rotation jn degrees.

d) By optimizing the valve timing, power and torque can be increased. Briefly explain how power is increased by varying the valve timing.

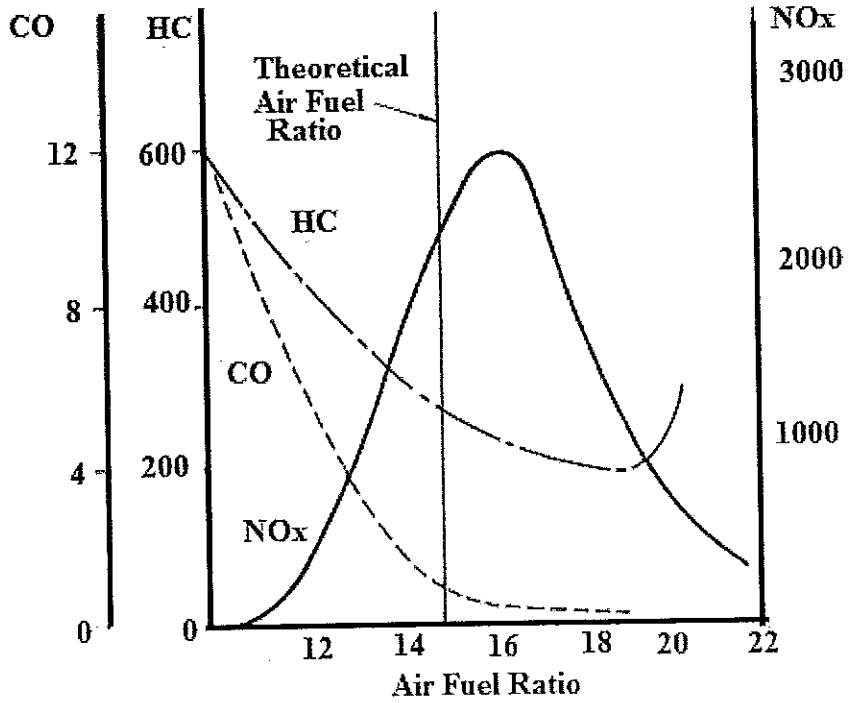

Figure Q5 – Relationship between Air-Fuel Ratio and production of exhaust gases.

Question 06

a) By means of block diagrams, briefly explain the main difference between point to point wiring system and CAN system.

b) Explain what is Message Arbitration with respect to CAN protocol.

c) List four alternative fuels for automobiles and describe their
   i. physical and chemical characteristics
   ii. production process and
   iii. exhaust emissions

d) List five basic measurements and their corresponding sensors that are being used to determine the correct amount of fuel to be injected when ME Motronic engine management system is used.

e) The configuration of a three cylinder two stroke engine is shown in figure Q6. Determine the magnitudes and directions of,

   i. Primary forces (F_p)
   ii. Primary couples (M_p)
   iii. Secondary forces (F_s)
   iv. Secondary couples (M_s)
   v. Forces due to revolving masses (F_g)
   vi. Couples due to revolving masses (M_R)

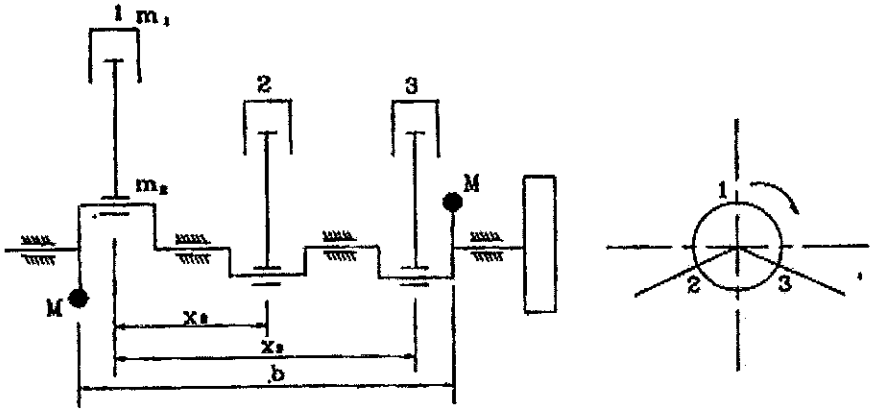

Figure Q6

QUESTION 07

a) 'While the mixture in the engine with carburetor and Port Fuel Jnjection (PFI) is prepared out of the cylinder, mixture in the gasoline direct injection (GDI) engine is prepared in-cylinder.'Explain the advantage of Gasoline Direct Injection system over port fuel injection.

b) Homogeneous charge and stratified chargeare two basic charge modes employedIn GDI engines. Briefly explain the homogeneous charge and stratified chargesystems separately.

c) What are the key differences between homogeneous charge and stratified chargemodes?

End