The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX6331 Automobile Engineering**
Academic Year	:	2013/14
Date	:	27th August 2014
Time	:	0930 hrs. – 1230 hrs.
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of two parts, A and B. 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.
3. All questions carry equal marks.

PART A

QUESTION 01

(a) Starting from first principles, derive an expression for the air standard efficiency of the Otto cycle in terms of compression ratio.

(b) A four-stroke, spark ignition engine was tested using a rope brake dynamomenter and the following results were obtained.

Dynamometer

Effective diameter of the brake pulley	- 600 mm
Difference in tensions on either side of the brake pulley	- 885 N

Engine

No. of cylinders	- 06
Bore diameter	- 90 mm
Stroke length	- 110 mm
Speed of the engine	- 3600 rev/min
Ratio of indicated thermal efficiency to air standard efficiency	- 0.55
Compression ratio	- 11
Air fuel ratio	- 15:1
Specific fuel consumption	- 0.27 kg/kWh
Calorific value of fuel	- 42 MJ/kg
Temperature of air inhaled	- 31°C

Pressure of air inhaled	- 103 kPa
Gas constant for air	- 0.287 kJ/kgK
Ratio of specific heats for air (γ)	- 1.4

Calculate the following.

(i) Air standard efficiency
(ii) Indicated thermal efficiency
(iii) Brake power
(iv) Brake mean effective pressure
(v) Volumetric efficiency
(vi) Mechanical efficiency

QUESTION 02

The following parameters are given for a typical four cylinder, four stroke, gasoline engine.

Volumetric efficiency	– 75%
Mechanical efficiency	– 80%
Calorific value of gasoline	– 42 MJ/kg
Excess air factor	– 10%
Pressure of the mixture at the end of suction stroke	– 8.3×10^4 Pa
Temperature of the mixture at the end of suction stroke	– 335 K
Gas constant for air	– 0.287 kJ/kgK
Stoichiometric air/fuel ratio	– 14.5:1

If the engine develops 100 kW at 3000 rev/min, determine the cylinder dimensions. Assume that the ratio of stroke to bore diameter is 1.2, indicated thermal efficiency is 29% and the densitiy of petrol vapour in the mixture is twice as that of air.

PART B

QUESTION 03

A four cylinder, four sroke engine with a bore diameter of 80 mm and a stroke of 100 mm is fitted with a single barrel carburettor. If the diameter of the emulsion tube is 0.35 times the diameter of the venturi, determine the diameter of the venturi. You may use the additional data given below.

Speed of the engine	- 4800 rev/min
Volumetric efficiency	- 72%
Atmospheric pressure	- 103 kPa
Universal gas constant for air	- 0.287 kJ/kgK
Ambient temperature	- 31°C

Ratio of specific heats	- 1.4
Air speed at the venturi at maximum power	- 390 m/s
Coefficient of discharge of venturi	- 0.85

QUESTION 04

The following data are available for a multi cylinder engine incorporating a motronic fuel injection system. Determine the fuel injection duration.

Stroke	- 140 mm
Bore diameter	- 120 mm
Volumetric efficiency	- 70%
Atmospheric pressure	- 103 kPa
Temperature	- 31°C
Universal gas constant for air	- 0.287 kJ/kgK
Air fuel ratio	- 14:1
Specific gravity of fuel	- 0.8
Air fuel ratio	- 14:1
Discharge rate of the fuel injector	- 0.075 ml/ms

QUESTION 05

Fig. Q5 shows a compound epicyclic gear train. The shaft P is driven at 400 rev/min while the annulus A_2 is driven at 1200 rev/min in the opposite direction. The number of teeth on the gears are given below.

Gear	No. of Teeth
S_1	16
S_2	24
A_1	60
A_2	90

Determine the speed of the shaft Q and its direction of rotation.

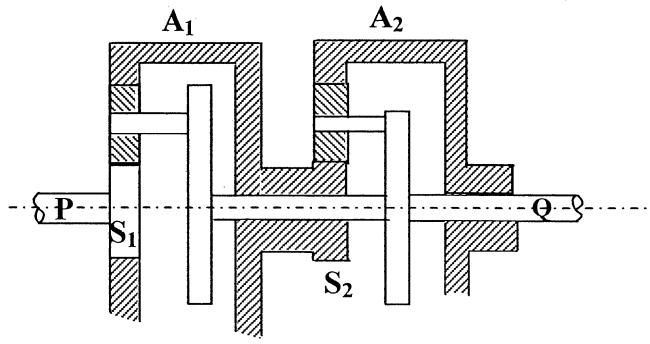

Fig. Q5

QUESTION 06

(a) Using a rough sketch, explain the architecture of Series hybrid and Parallel hybrid configurations.

(b) Define the term 'speed ratio' in relation to the traction motor characteristics. Draw typical variable speed traction motor characteristic curves (Power vs. motor speed and Torque vs. motor speed) for Electrical Vehicles (EVs) and briefly explain its operation at low speeds and high speeds.

(c) "The use of Multi-gear or Single-gear transmission for EVs depends mostly on the motor torque-speed characteristics". Briefly explain this statement.

QUESTION 07

(a) Explain the application, construction and operating principle of the following sensors used in electronically controlled fuel injection systems.

(i) Hot wire air mass meter
(ii) Oxygen sensor

(b) Briefly explain the operating principle of the Traction Control System (TCS), and how a TCS can be extended to improve the stability control of a vehicle specially in cornering.

(c) What is the difference between Supercharging and Turbocharging? Explain the function of the waste gate valve in a turbo charger.

QUESTION 08

(a) Explain the relative advantages of a fuel injection system over a carburettor.

(b) Define the term 'camber' in relation to the steering geometry and explain the benefits of having positive camber for vehicles.

(c) Explain the construction and function of <u>one</u> of the following exhaust emission control systems.

(i) Exhaust gas recirculation system
(ii) Three-way catalytic converter