TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION 2013/2014

FOURTH YEAR UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2420 : INTERNAL COMBUSTION ENGINES

TIME: 2 HOURS **SERIES:** DECEMBER, 2013

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
   - Drawing Instruments
   - Scientific Calculator

2. This paper has **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. This paper consists of **FOUR** ***Printed pages.***

QUESTION 1

(a) Distinguish between turbocharging and supercharging. **(4 marks)**

(b) Explain the following in fuel infection:

(i) Charge stratification **(2 marks)**
(ii) Carburetion **(2 marks)**

(c) Distinguish between the following:

(i) Carburators
(ii) Vacuum feed
(iii) Pulse feed

(d) The average indicated power in a compression ignition engine is 12.9kw/m^3 of free air induced per minute. The engine is a 3 litre four stroke engine running at 3500rpm and has volumetric efficiency of 80%, referred to free air conditions of 1.013 bars and 15^{o}C. It is proposed to fix a blower, driven mechanically from the engine. The blower has an isentropic efficiency of 75% are works through a pressure ratio of 1:7. Assume that at the end induction, the cylinders equal to swept volume, at the pressure and temperature of delivery from the blower. Calculate the increase in brake power to be expected from the engine. Take all mechanical efficiency as 80%. **(11 marks)**

QUESTION 2

(a) Define the following:

(i) Indicated power
(ii) Brake power
(iii) Brake thermal efficiency
(iv) Specific fuel consumption
(v) Indicated thermal efficiency

(5 marks)

(b) A four cylinder petrol engine has a bore of 57mm and a stroke of 90mm. It is rated speed is 2800rpm and it is tested at this speed against a brake which has a torque arm of 356mm. The net brake load is 155N and fuel consumption 6.74litres/hr. The specific gravity of petrol used is 0.735 and it has a lower calorific value, Q_{net}, V of 44,200kJ/kg. A morse test is carried out and cylinders are cut in order 1, 2, 3 and 4 with corresponding brake loads of 111N, 106.5N, 104.2N and 111N, respectively:

Calculate for this speed:

(i) Indicated load **(2 marks)**
(ii) Engine torque **(2 marks)**
(iii) Specific fuel consumption **(2 marks)**
(iv) The BMEP **(2 marks)**
(v) Brake thermal efficiency **(2 marks)**
(vi) Indicated mean effective pressure **(2 marks)**
(vii) Mechanical efficiency **(2 marks)**

(b) An analysis of dry exhaust from the above showed no oxygen and negligible carbon monoxide. The engine was tested in an atmosphere at 1.013bars and 15^{o}C. Take air fuel

ratio of 14.5 for petrol engines. Calculate the volumetric efficiency of use engine. Take mass flow rate as 1.376g/s. **(6 marks)**

QUESTION 3

(a) Explain the following parameters:

(i) Stoichrometric air fuel ratio
(ii) Octane number
(iii) Proximate analysis
(iv) Ultimate analysis
(v) Cetane number

(10 marks)

(b) A sample of dry a nitrate has the following composition by mass.
. Carbon - 90%, Hydrogen = 3%, Oxygen = 2.5%, Sulphur = 0.5%, Ash = 3%.

If 20% excess air is supplied:

(i) Calculate the shouhrometric air fuel ratio
(ii) Analyze wet products by mass and percentage
(iii) Analyze dry products by mass and percentage

(10 marks)

QUESTION 4

(a) Discuss any **EIGHT** engine emission pollutant, their causes and control measures. **(8 marks)**

(b) (i) Define a hybrid car. **(2 marks)**
(ii) Outline the main features and benefits of a hybrid car. **(6 marks)**

(c) State and explain:

(i) 3 typologies of hybrid cars
(ii) **FOUR** hybrid levels

(d) State any time baltenes used in hybrid cars. **(2 marks)**

QUESTION 5

(a) State any **FIVE** assumptions made in analysis of our standard cycles. **(5 marks)**

(b) Outline the major differences between an air standard cycle and a practical diesel ensure cycle. **(4 marks)**

(c) A diesel engine has intake temperature of 15°C and 1 bar respectively. The compression ratio is 12/1 and maximum cycle temperature is 1100°C.

(i) Illustrate the process on a Pu and Ts diagram. **(4 marks)**

(ii) Calculate the cycle efficiency **(6 marks)**

Take Cp = 1.005kJ/kg, C_v = 0.718kJ/kg

(d) Show that for octo cycle, the cycle efficiency is:

$$1-\left(\frac{1}{r_c}\right)\gamma-1$$

Where: r_C = Compression ratio

γ = Adiabatic ratio

(6 marks)