BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, DUBAI CAMPUS
II SEMESTER 2013-2014
COMPREHENSIVE EXAMINATION (Open Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 27.05.2014**
Course No. : ME F242	**Course Title : Internal Combustion Engines**	
Duration : 3 hrs	**Marks: 80**	**Weightage : 40 %**

Notes: *(i) answer all the questions (ii) Draw neat sketches wherever necessary*
(iii) Make suitable assumptions if required and clearly state them

PART-A

Q.1. A four cylinder four-stroke spark ignition petrol engine gave the following particulars:
Bore: 6.5 cm Stroke: 9.5 cm Speed: 3000 rpm
Clearance volume: 65 cm^3 Relative efficiency based on brake thermal efficiency: 50 %. Calorific value: 46000 kJ/kg. When tested on load it developed 70 N-m Torque. Assume γ for air = 1.4 and mechanical efficiency of 80 %. Determine (i) Relative efficiency (ii) Brake power (iii) Mass of fuel supplied in kg/hr (iv) Specific fuel consumption and (v) Mean effective pressure in bar. [8 m]

Q.2 One kg of air taken through a Diesel cycle. Initially the air is at 15^0C and 1 atm. The compression ratio is 15 cm and the heat added is 1850kJ. Take R for air = 0.287 kJ/kg-k. Calculate (i) Initial volume of air (ii) Maximum cycle temperature (iii) Temperature at the end of expansion (iv) ideal cycle efficiency and (v) mean effective pressure. [8m]

Q.3 (a) Why the actual cycle for IC engines differ from air standard cycle efficiency? List out the reason. [5m]
(b) List three principal factors that influence engine performance with respect to actual and air standard cycle. [5m]

Q.4 Bring out clearly the process of combustion in CI engines and also explain the various stages of combustion with neat sketch. [7 m]

Q.5 (a) What are catalytic converters? How are they helpful in reducing HC,CO and NO_X emissions ? [7m]

PART-B

Q.1. A single cylinder oil engine working on four stroke cycle has bore 11 cm and stroke 13 cm and runs at 600 rev/min. The mean effective pressure is 7 bar. It uses 1.17 kg of oil per hour having a Calorific Value of 44520 kJ. The cylinder jacket cooling water enters at a temperature of 18°C and leaves at 60°C. The quantity of water being circulated 95 kg per hour. The rope brake dynamometer wheel diameter is 85 cm and rope diameter is 2 cm. The net load on the brake is 110 Newton.

Calculate IP, BP, FP, Indicated and brake thermal efficiency and mechanical efficiency. Draw up percentage heat balance sheet in kJ/min. assuming that 6% of the heat supply is lost by radiation. Take specific heat of water= 4.187 kJ/kg K [8m]

Q.2 A 4-stroke petrol engine 7 cm bore and 9 cm stroke is tested at full throttle at constant speed. The fuel supply is fixed at 0.065 kg per minute and the plugs of the 4 cylinders are successively short circuited without change of speed, brake torque being correspondingly adjusted. The power measurements are the following:

With all cylinders firing	11.91 kW
With cylinder No.1 short circuited	8.46 kW.
With cylinder No.2 short circuited	8.56 kW
With cylinder No.3 short circuited	8.6 kW
With cylinder No.4 short circuited	8.5 kW

Determine (i) indicated power (II) Indicated thermal efficiency if the calorific value of the fuel is 43 500 kJ/kg. (III) air standard efficiency (iv) Relative efficiency. Assume clearance volume of one cylinder being 69.5 cm^3 [8m]

Q.3 Discuss the actual valve timing diagram of a CI engine with neat sketch. [5m]

Q.4 What is meant by abnormal combustion? Explain the phenomena of knock in SI engines with neat diagram. [7m]

Q.5 (a) Compare LPG and Petrol as a fuel for SI engine. [5m]

(b) What do you understand by the term EGR? Explain how EGR reduces NO_X emissions? [7m]

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Test No.2 (Open Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 14.04.2014**
Course No. : ME F242	**Course Title : Internal Combustion Engines**	
Duration : 50Min	**Marks: 40**	**Weightage : 20 %**

Notes: *(i) answer all the questions (ii) Draw neat sketches wherever necessary*
(iii) Make suitable assumptions if required and clearly state them

Q.1. The following observations were made during the test on a 6 cylinder, 4 stroke diesel engine:

Bore: 120 mm, Stroke: 120 mm, Speed: 2400 rpm

Load on hydraulic dynamometer: 480 N, Dynamometer constant: 16000

Air orifice diameter: 60 mm, Ambient temperature: 20^0C

Discharge coefficient of orifice: 0.65, Fuel consumption: 21.75 kg/hr

Head causing flow through orifice: 32 cm, Density of air @ 20^0C: 1.205 kg/m^3

Calorific value of fuel: 45000 kJ/kg,

Determine the following: (a) Power at brake (b) Brake mean effective pressure

(c) Brake specific fuel consumption kg /kWh (d) Brake thermal efficiency

(e) Actual volume of air per cylinder (f) Volumetric efficiency per cylinder (15 M)

Q.2. (a) What do you mean by preparatory phase with reference to delay period and indicate it neat sketch. Explain why it does not happen in SI engine. (5 M)

(b) Explain and distinguish with neat diagram how ignition and flame starts in SI and CI engines. (5 M)

Q.3 What is meant by pre-ignition? In which category of engine does it normally happen and will it cause detonation in the engine ? Justify your answer. (5 M)

Q.4. A four cylinder four stroke petrol engine of 6.35 cm bore and 8.9 cm stroke was tested at full throttle and constant speed. The fuel supply was fixed at 0.064 kg per minute and the plugs of the cylinders were short circuited without change of speed the brake torque being corresponding adjusted. Assume the frictional and pumping losses remain constant. The Brake power measurements were as follows:

With all cylinders 15.3 kW
With cylinder No. 1 cut out 11.9 kW
With cylinder No. 2 cut out 11.8 kW
With cylinder No. 3 cut out 11.7 kW
With cylinder No. 4 cut out 11.85 kW

Estimate the indicated power of the engine conditions. Find indicated thermal efficiency of the engine if the Calorific Value of the fuel used is 43680 kJ per kg. If clearance volume of one cylinder is 70.3 cm^3 determine compression ratio, air standard efficiency. Take $\gamma = 1.4$ (10 M)

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Test No.1 (Closed Book)

Year : II-MECHANICAL	Section: 1 and 2	Date : 03.03.2014
Course No. : ME F242	Course Title : Internal Combustion Engines	
Duration : 50Min	Marks: 50	Weightage : 25 %

Notes: (i) answer all the questions (ii) Draw neat sketches wherever necessary
(iii) Make suitable assumptions if required and clearly state them

Q.1. **(a)** Show by means of a diagram the energy flow in a reciprocating internal combustion engine. (7 M)

(b) What do you mean by Scavenging? Briefly explain with neat sketch? (8 M)

Q.2. A six cylinder four stroke cycle petrol engine is to be designed to develop **300 kW** of brake power at **2500 RPM**. The bore stroke ratio is to be **1: 1.25** and the compression ratio of the engine is to be **6.5 : 1.** Assuming a mechanical efficiency of **83 %,** relative efficiency is **55 %,** calorific value of the petrol is **44770 kJ/ Kg** and indicated mean effective pressure of **9.5 bar**. Take γ for air = 1.4 determine (a) Indicated power (b) required bore and stroke (c) Air standard efficiency (d) Indicated thermal efficiency (e) consumption of petrol in kg/hr. (15 M)

Q.3 **(a)** If 6 cylinder 4-stroke petrol engine has swept volume of 300 cm^3 per cylinder, compression ratio of 10 . If the engine is required to develop an output of 75 kW , calculate the cycle efficiency, the necessary rate heat of addition, the mean effective pressure and maximum temperature of the cycle. Assume the engine operates an Otto cycle and that the pressure and temperature before isentropic compression are 1 bar and 15 ^{0}C respectively. Take C_p = 0.718 kJ/kg-K

(b) If the above engine is a compression ignition engine on Diesel cycle and receiving heat at the same rate, calculate the efficiency, the maximum temperature of the cycle, power output and mean effective pressure. (20 M)

-------- All the Best----------

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QUIZ.2 (Closed Book)

Year : II-MECHANICAL	Section: 1 and 2	Date : 12.05.2014
Course No. : ME F242	Course Title : Internal Combustion Engines	
Duration : 20Min	Marks: 21	Weightage : 7 %

STUDENT NAME:----------I.D No:----------

INSTRUCTOR NAME:_____

Q.1 Engine emissions are classified into two types of categories [1m]

(i)----------

(ii)----------

Q.2. Amount of emissions in exhaust flow in SI engine increases with fuel-air equivalence ratio [1m]

(a) CO only (b) HC only (c) CO and HC both (d) none

Answer ☐

Q.3 When oil consumption rate increases in SI engine HC emission [1m]

(a) Increases (b) decreases (c) increases and decreases (d) constant

Answer ☐

Q.4 Generation of NOx in SI engine with increase of spark timing [1m]

(a) Increases (b) decreases (c) increases and decreases (d) constant

Answer ☐

Q.5. At very high temperature in the combustion chamber the following reactions occurs. [1m]

(a) $N_2 \rightarrow 2N$ (b) $NO + O_2 \rightarrow NO_2 + O$ (c) $N + OH \rightarrow NO + H$

(d) $O + N_2 \rightarrow NO + N$

Answer ☐

Q.6 Lead componds were added in gasoline to [1m]

(a) Reduce HC emissions (b) Reduce Knocking

(c) reduce exhaust temperature (d) Increase power output

Answer ☐

Q.7 Chemiluminiescence technique is used to measure [1m]

(a) NO_X (b) CO (c) CO_2 (d) Smoke

Answer ☐

Q.8 EGR is the most effective way of reducing emissions [1m]

(a) NO_X (b) CO (c) HC (d) CO and HC

Answer ☐

Q.9 The causes for hydrocarbon emissions from SI engines are [1m]

(a) Valve over lap (b) crank case blowby (c) catalytic convertor

(d) Aldehydes

Answer ☐

Q.10 The additive Tetraethyl lead was effectively used to increase gasoline [1m]

_____

Q.11 Photochemical Smog is caused by [1m]

(a) NO_X (b) CO (c) HC (d) smoke

Answer ☐

Q.12 In catalytic convertor the palladium and platinum promote the oxidation of _____ [1m]

Q.13 _____is the base ceramic material used for most catalytic convertor [1m]

(a) Palladium (b) Platinum (c) Rhodium (d) Alumina

Answer ☐

Q.14 The three way catalytic convertors reduce emission of [1m]

(a) CO, CO_2, and soot (b) CO, NO_X and HC (c) CO_2, NO_X and HC

(d) CO, HC and SO_2

Answer [ ]

Q.15 .What are the sources of Non-Exhaust emissions from automobile. [1.5m]

Answer:

(i)_____

(ii)_____

(iii)_____

Q.16 Write formula to find out total fraction of exhaust in the engine cylinder [2 m]

Answer:

Q.17 Define Flame Quenching [2 m]

Answer:

Q.18 Define crankcase blowby [1.5 m]

Answer:

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QUIZ.1 (Closed Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 24.03.2014**
Course No. : ME F242	**Course Title : Internal Combustion Engines**	
Duration : 20Min	**Marks: 16**	**Weightage : 8 %**

STUDENT NAME:----------I.D No:----------

INSTRUCTOR NAME:_____

1. The theoretically correct mixture of air and petrol is [1M]
   a) 10 :1 b) 15 :1 c) 20 :1 d) 25 :1

   Answer ☐

2. Diesel as compared to petrol is [1M]
   a) Highly ignitable
   b) less difficult to ignite
   c) More difficult to ignite
   d) none of these

   Answer ☐

3. In an otto cycle, Pressure at the beginning of compression is 1 bar at the end of compression is 11 bar. Calculate the air-standard efficiency of the engine. Assume γ= 1 [A] 50.6 % [B] 49.6 % [C] 48.6 % [D] 47.6 % [1M]

   Answer ☐

4. A six cylinder, four stroke CI engine is tested. Find the swept volume. During the test following observations were taken: [2.5M]
   a) Bore : 10 cm b) Stroke : 14 cm c) Speed : 2500 rpm

   Solution

5. A More test is carried out in 2 cylinder, 4 stroke in SI engine having total cylinder brake load of 6 kW. The cylinders are cut out in the order 1 and 2 with corresponding brake load of 2 kW and 3 kW.(a) Indicated power (b) Mechanical efficiency [2.5M]

Solution

6. In a rope brake method , the measurement BP in Watt is given by [2M]

(a) $\frac{(W-s)\pi DN}{60}$ or (b) $\frac{(W+s)\pi DN}{60}$. Which is true ? Why ?

Answer

Comments:

7 Find the fuel consumption in kg/hour, in a IC engine testing , 200 cc fuel is collected in 300 min. The density of fuel is 1020 kg/m^3 [2M]

Solution

8. When a IC engine is tested against dynamometer with a torque arm of 35 cm, a net brake load of 157 N was obtained at the rated speed of 500 rev per sec. Find the shaft power in Watt per cylinder [2M]

Solution

9 The IC engine was tested in an atmospheric pressure of 1 bar and 15 ^{0}C and stoichiometric air fuel ratio was 15, determine the actual volume for the engine. Fuel consumption was 0.082 kg/min [2M]

Solution