BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, DUBAI CAMPUS

II SEMESTER 2012-2013

COMPREHENSIVE EXAMINATION (Closed Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 05.06.2013**
Course No. : ME F242	**Course Title : I C Engines**	
Duration : 3 hrs	**Marks: 80**	**Weightage : 40 %**

Instructions: (i) *Answer all the questions* (ii) *Draw neat sketches wherever necessary*

(iii) *Make suitable assumptions if required and clearly state them*

(iv) Marks are shown in the brackets against each (v) Answer **PART A** and **PART B** on separate answer books

PART-A

Q.1. An engine working on otto cycle has a volume of **0.5m^3**, pressure **1** bar and temperature **27^{0}C** at the commencement of compression stroke. At the end of the compression stroke the pressure is **10 bar**. Heat added during the constant volume process is **200 kJ.** Calculate the pressure, temperature and volumes at salient points in the cycle.

Also find (a) percentage clearance (b) heat rejected by cycle (c) air standard efficiency and (d) mean effective pressure in bar.

If the engine runs at **400** rev/min, so that there are **200** complete cycles per minute, calculate work done per minute developed by the engine. Take **R** for air **= 0.287** kJ/kgk; **c_v = 0.718** kJ / kg-K and **γ = 1.4** [10 M]

Q.2. 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 12.3 kW

With cylinder No. 1 cut out 8.9 kW

With cylinder No. 2 cut out 8.8 kW

With cylinder No. 3 cut out 8.7 kW

With cylinder No. 4 cut out 8.85 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. [08 M]

Q.3. Bring out clearly the process of combustion in CI engines and also explain the various stages of combustion with neat sketch. [08 M]

Q.4. Describe with suitable example the causes of **HC** emissions from SI engines. [08 M]

PART-B

Q.5. A single cylinder 4 stroke cycle gasoline engine is to operate at 400 r.p.m. and deliver 75 kW. Determine:

i) The bore and stroke

ii) The brake thermal efficiency

iii) The indicated thermal efficiency

iv) The airstandard efficiency

v) The indicated mean effective pressure, from the following data:

Brake mean effective pressure	= 8.4 bar
Mechanical efficiency	= 80 %
Specific fuel consumption	= 0.254 kg/bp kWh
Lower heating value of fuel	= 44300 kJ /kg
Ratio of stroke to diameter	= 1
Ratio of compression	= 6.5

Take for air, $\frac{c_p}{c_v} = 1.4$ [10M]

Q.6. The following results were obtained during a test on a single cylinder four stroke cycle oil engine using rope brake dynamometer.

Cylinder diameter	= 25 cm
Stroke	= 38 cm
Duration of test	= 60 minutes
Total revolutions	= 19710 minutes
Fuel oil used	= 6.25 kg
Average area of indicator diagram	= 5.7 cm^2
Length of indicated diagram	= 7.6 cm
Spring number	= 8.35 bar per cm
Net load on the brake	= 635 N at 1.2 m radius
Cooling water	= 5.7 kg/min with temperature = 44°C
Atmospheric temperature	= 15.5°C
Air supplied per kg of fuel	= 30 kg
Calorific Value of the fuel	= 44520 kJ / kg
Exhaust gas temperature	= 390°C

Assuming mean specific heat of exhaust gases 1.0 kJ/kg K, calculate the IP, BP developed and heat equivalent to FP. Draw up a heat balance on a basis of one minute and express each time as a percantage of heat supplied. [10M]

Q.7. (a) Briefly explain with help of a suitable sketch of the theoretical and actual '**pv**' diagram for 4 stroke diesel engine. [04M]

(b) Discuss the differences between actual valve timing diagram of a SI engine and CI engine with neat sketch. [08M]

Q.8. (a) Explain in detail the stages of combustion in SI engines elaborating the flame front propagation. [08M]

(b) Briefly explain the role of Natural Gas as an alternate fuel in **SI** engine. [06M]

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II SEMESTER 2012-2013

Test No.2 (Open Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 01.05.2013**
Course No. : ME F242	**Course Title :**	**I C 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 Describe with suitable sketch for the following factors in SI engine. How it is differs from each others.

a) Normal Combustion (b) Detonation (c) Pre-Ignition [15 M]

Q.2. A six cylinder, four stroke CI engine is tested against a water brake dynamometer. The air consumption was measured by means of a sharp edged orifice. For volume flow rate of air use the relation $C_d A \sqrt{2gh_a}$

During the test following observations were taken:

a) Bore	: 10 cm
b) Stroke	: 14 cm
c) Speed	: 2500 rpm
d) Brake load	: 480 N
e) Atmosphere pressure	: 101.4 kN/m^2
f) Orifice diameter	: 3.3 cm
g) Dynamometer constant	: 17
h) Co-efficient of discharge of orifice	: 0.62
i) Pressure drop across orifice	: 18.678 X 10^3 N/m^2
j) Room temperature	: 25^0 C
k) Fuel consumption	: 0.32 kg/min
l) For air 'R'	: 0.287 kJ/kg-k

Calculate the following:

(a) Volume flow rate of air (b) Volumetric efficiency

(c) Brake mean effective pressure (d) Engine Torque

(e) Brake specific fuel consumption [18 M]

Q.3. A More test is carried out in 4 cylinder, 4 stroke in SI engine having total cylinder brake load of 15.6 kW. The cylinders are cut out in the order 1, 2, 3, 4 with corresponding brake load of 11.1 kW, 11.03 kW, 10.88 kW, and 10.66 kW. Assuming that the engine is running at constant speed with fixed setting of fuel supply of 6.0kg/hr, and the frictional and pumping losses remain constant. If the calorific value of the fuel is 83600kJ/kg calculate:

(a) Indicated power (b) Mechanical efficiency (c) Indicated thermal efficiency. [7 M]

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II SEMESTER 2012-2013

Test No.1 (Closed Book)

Year : II-MECHANICAL	**Section: 1 and 2**	**Date : 13.03.2013**
Course No. : ME F242	**Course Title : I C 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 Following data are available for a Four Cylinder four stroke petrol engine:

Air fuel ratio (by mass)	15.5:1
Calorific value of fuel	15000kJ / kg
Mechanical efficiency	80%
Air standard efficiency	53%
Relative efficiency	70%
Volumetric efficiency	80%
Stroke / bore ratio	1.25
Suction conditions	1 bar 27°C
r.p.m.	2400
Power at brakes	75 kW

Calculate

a) compression ratio, b) indicated thermal efficiency,

c) brake specific fuel consumption, d) bore and stroke. [21 M]

Assume air as working substance with R = **0.287 kJ/kg-k** and **γ = 1.4**

Q.2 An ideal dual combustion cycle has a stroke volume of 0.01 m^3 of the air with a compression ratio of 16. The pressure and temperature of air at the commencement of adiabatic compression is 1 bar and 27^{0}C respectively. The heat is added at constant pressure of 70 bar and for 5% of the stroke.

Calculate

a) Pressure ratio, b) cut – off ratio,

c) mass of air obtained in the cylinder, d) heat added per cycle,

e) heat rejected per cycle, f) work done per cycle,

g) thermal efficiency of the cycle, h) mean effective pressure

Take C_p = 1kJ /kg K and C_v = 0.714 kJ/kg K

Assume air as working substance with **C_p = 1 kJ/kg-k**, **C_v = 0.714 kJ/kg-k** **R = 0.287kJ/kg-k** and **γ = 1.4** [21 M]

Q.3 Compare SI and CI engines with respect to (i) Basic cycle (ii) Introduction of fuel (iii) Ignition (iv) Compression ratio (v) Thermal efficiency (vi) Weight [08 M]

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BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, DUBAI CAMPUS

II SEMESTER 2012-2013

QUIZ-1 (Closed Book)

Year : II-MECHANICAL	**Section; 1 & 2**	**Date : 26.03.2013**
Course No. : ME F242	**Course Title : INTERNAL COMBUSTION ENGINES**	
Duration : 50Min	**Marks: 16**	**Weightage : 8 %**

QUESTIONS

Qns	1	2	3	4	5	6	7	8	9	10	11	12
Ans												

Qns	13	14	15	16
Ans				

1. In a four stroke engine, the working cycle is completed in
   a) One revolution of the crankshaft
   b) two revolutions of the crankshaft
   c) three revolutions of the crankshaft
   d) four revolutions of the crankshaft

2. The thermodynamic cycle on which the petrol engine works, is
   a) Otto cycle
   b) Joule cycle
   c) Rankine cycle
   d) Stirling cycle

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

4. In a petrol engine, the charge is ignited with the help of a spark plug.
   a) Yes
   b) No

5. Stoichiometric ratio is
   a) Chemically correct air-fuel ratio by weight
   b) Chemically correct air-fuel ratio by volume
   c) Actual air-fuel ratio for maximum efficiency
   d) None of the above

6. The pressure inside the cylinder is _____ the atmospheric pressure during the exhaust stroke
   a) Equal to
   b) Below
   c) Above

7. In diesel engines, the ignition takes place due to the heat produced in the engine cylinder at the end of compression
   a) Correct
   b) Incorrect

8. The diesel engines are also known as _____ engines
   a) Compression ignition
   b) Spark ignition

9. Diesel as compared to petrol is
   a) Highly ignitable
   b) More difficult to ignite
   c) less difficult to ignite
   d) none of these

10. A petrol engine, during suction stroke draws
   a) Air only
   b) Petrol only
   c) A mixture of petrol and air

11. A diesel engine, during suction stroke draws
   a) Air only
   b) Diesel only
   c) A mixture of diesel and air

12. A carburetor is used to supply
   a) Petrol, air and lubricating oil
   b) air and diesel
   c) Petrol and lubricating oil
   d) Petrol and air

13. The break power is the power available
    a) In the engine cylinder
    b) At the crank shaft
    c) At the crank pin
    d) None of these

14. The mechanical efficiency (η_m) of the engine is given by
    a) $\eta_m = \frac{B.P.}{I.P.}$
    b) $\eta_m = \frac{I.P.}{B.P.}$
    c) $\eta_m = \frac{B.P. \times I.P}{100}$
    d) None of these

15. The fractional power (F.P.) is given by
    a) F.P. = B.P. – I.P.
    b) F.P. = B.P. / I.P.
    c) F.P. = I.P. – B.P.
    d) F.P. = I.P. / B.P.

16. The air standard efficiency of an I.C. engine is given by
    a) $1 - r^{\gamma-1}$
    b) $1 + r^{\gamma-1}$
    c) $1 - \frac{1}{r^{\gamma-1}}$
    d) None of these

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