

S.E. (MECH.) (Second Semester) EXAMINATION, 2010

I.C. ENGINES AND AUTOMOBILE ENGINEERING

(2003 COURSE)

Time : Three Hours

Maximum Marks : 100

N.B. :— (i) Answer 3 questions from Section I and 3 questions from Section II.

(ii) Answers to the *two* sections should be written in separate answer-books.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Figures to the right indicate full marks.

(v) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(vi) Assume suitable data, if necessary.

SECTION I

Unit I

1. (a) Why the actual cycle efficiency is much lower than the air standard cycle efficiency ? List the major losses and differences in actual engine cycle and air-standard cycle. [8]
- (b) A four-cylinder, four-stroke S.I. Engine has a displacement volume of 300 CC per cylinder. The compression ratio of the engine is 10 and operates at a speed of 3000 r.p.m. The engine develops an out-put of 40 kW at this speed.

P.T.O.

Calculate :

- (i) The air standard efficiency
- (ii) Rate of Heat addition
- (iii) The mean effective pressure
- (iv) The maximum temperature of the cycle.

Assume the pressure and temperature at initial conditions are 1 bar and 27°C respectively. Take $C_v = 0.717$ kJ/kgK and $\gamma = 1.4$. [10]

Or

2. (a) Explain with neat sketches, the valve timing diagrams for low and high speed petrol engine. [4]
- (b) Compare air standard Otto, diesel and dual cycles on the following basis with P-V and T-S diagram. [6]
- (i) Same compression Ratio and heat rejection
 - (ii) Same maximum pressure and heat input.
- (c) The air-fuel ratio of a Diesel engine is 31 : λ . If the compression ratio is 15 : 1 and temperature at the end of compression is 1000 K. Find at what percentage of stroke is the combustion complete if the combustion begins at TDC and continues at constant pressure. Calorific value of the fuel is 40000 kJ/kg. Assume the variable specific heat $C_p = a + bT$, where $a = 1$ and $b = 0.28 \times 10^{-4}$. [8]

Unit II

3. (a) Explain common rail diesel injection system with a neat sketch. State its advantages. [8]
- (b) A simple jet carburetor is required to supply 4.6 kg of air per minute. The pressure and temperature of air are 1.013 bar and 25°C respectively. Assuming flow to be isentropic and compressible and velocity coefficient as 0.8, calculate the throat diameter of the choke for air flow velocity of 80 m/s. Take $C_p = 1.005 \text{ kJ/kgK}$, $\gamma = 1.4$. [8]

Or

4. (a) State the need of petrol injection system. Explain MPFI system with a neat sketch. [8]
- (b) What are functional requirements of a fuel injection system ? Explain any four types of nozzle with merits and demerits. [8]

Unit III

5. (a) Why spark advance is required in SI engine ? Explain any one spark advance mechanism. [6]
- (b) List the method used for governing of IC engines. Explain the governing system generally used in SI engine. [6]
- (c) What is function of radiator and thermostate ? Explain with neat sketch in cooling system. [4]

Or

6. (a) What are the functions of lubrication system ? Explain dry sump lubrication system. [8]
- (b) Explain firing order of IC engine. [4]
- (c) Explain evaporative cooling system for I.C. engines. State its advantages. [4]

SECTION II

Unit IV

7. (a) A 4-cylinder, 4-stroke petrol engine has a compression ratio of 7 to 1. The following observations were recorded during a trial :

| | |
|---------------------------|--|
| Net brake load | = 20 kg |
| Effective arm | = 1m |
| imep | = 15×10^{-5} N/m ² |
| Speed | = 2200 r.p.m. |
| Fuel consumption | = 12 kg/hr |
| C.V. of fuel | = 45000 kJ/kg |
| Diameter of cylinder bore | = 90 mm |
| Engine stroke | = 110 mm |

$$\frac{C_p}{C_v} = 1.4 \text{ for air}$$

Calculate :

- (i) Mechanical efficiency
- (ii) Brake thermal efficiency
- (iii) Indicated thermal efficiency
- (iv) Air standard efficiency
- (v) Relative efficiency on BP basis.

If the compression ratio is increased to 8, what will be the effect on relative efficiency ? Assume all the other data remaining the same. [12]

- (b) What is the necessity of I.C. engine testing ? What are the basic measurements, carried out for I.C. engine testing ? [6]

Or

8. (a) Why single cylinder engines are generally not supercharged ? What are the advantages and limitations of turbo-charging ? [6]

- (b) During a test on a 4-stroke cycle oil engine the following data and results were obtained : [12]

Mean height of indicator diagram = 21 mm,

C.V. of fuel = 44000 kJ/kg

Indicator spring number = 27 kN/m²/mm.

Cooling water circulation = 0.15 kg/s.

Swept volume of cylinders = 14 litres, cooling water inlet temperature = 38°C.

Speed of engine = 6.6 rev/s

Cooling water outlet temperature = 71°C

Effective brake load = 77 kg.

Specific heat capacity water = 4.18 kJ/kgK

Effective brake radius = 0.7 m,

Energy of exhaust gases = 33.6 kJ/s.

Fuel consumption = 0.002 kg/s.

Determine the indicated and brake outputs and the mechanical efficiency. Draw up an overall energy balance in kJ/s and as a%.

Unit V

9. (a) Describe with the help of a neat diagram the combustion phenomenon in SI engines. [8]
- (b) Explain the phenomenon of Diesel knock ? Compare diesel knock with detonation in SI engines. [8]

Or

10. (a) What is ignition delay ? What are the engine variables that affect delay period ? [8]
- (b) List the combustion chambers used for S.I. engines. Explain any one with a neat sketch. [8]

Unit VI

11. (a) What are the various requirements of engine for automotive applications ? [8]
- (b) Write a short note on hybrid vehicles. [8]

Or

12. (a) What are the major pollutants found in the CI engine emissions ? [8]
- (b) State PUC norms in India for different types of vehicles. [8]