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Printed Pages : 4

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BT - 5 / D-19

IC. ENGINES AND GAS TURBINES

Paper--ME-301 E

Time allowed : 3 hours] *[Maximum marks : 100*

Instructions:

(i) There are eight questions in this paper. All questions carry 20 marks.

(ii) Attempt five questions in all by selecting at least one from each section.

Section--A

1. (a) The pressure and temperature of a Diesel cycle at the start are 1 bar and 17°C. The pressure at the end of compression is 40 bar and that at the end of expansion is 2 bar. Find the air standard efficiency. Assume γ = 1.4. 10

(b) Define mean effective pressure and comment its application in internal combustion engines. 04

(c) Draw the Otto, diesel and dual cycles on p-V and T-S diagrams, mark the various processes. 6

2. A compression ignition engine has a compression ratio of 10 and 2/3 of heat of combustion is liberated at constant volume and the remainder at constant pressure. The pressure and temperature at the beginning are 1 bar and 27°C and the maximum pressure is 44 bar. Find the temperature at the end of

compression and expansion, if it follows the law $pV^{1.35}$ = constant and $\gamma = 1.4$. 20

Section--B

3. (a) A two stroke CI engine develops a brake power on 310 kW while its frictional power is 73.6 kW. Its fuel consumption is 180 kg/h and works with an air fuel ratio of 22:1. The heating value of fuel is 42000 kJ/kg. Calculate (i) Indicated power (ii) Mechanical efficiency (iii) Air consumption per hour (iv) Indicated thermal efficiency and (iv) Brake thermal efficiency. 12

(b) Describe in brief the variables affecting delay period. Also discuss knocking in CI engines. 8

4. (a) Define detonation. Also explain the various theories of detonation. 8

(b) A 10 cm × 12 cm four cylinder, 4- stroke engine running at 2000 revolutions per minute has a carburetor venturi with a 3cm throat. Determine the suction at the throat assuming the volumetric efficiency of the engine to be 70 %. Assume the density of air to be 1.2 kg/m^2 and coefficient of air flow 0.8. 12

Section--C

5. A four stroke gas engine has a cylinder diameter of 25 cm and stroke 45 cm. The effective diameter of the brake is 1.6 m. The observations made in a test of the engine were as follows: 20

Duration of test = 40 min

Total number of revolutions = 8080

Total number of explosions = 3230

Net load on the brake = 90 kg

Mean effective pressure = 5.8 bar

Volume of gas used = 7.5 m^3

Pressure of gas indicated in meter = 1.36 mm water of gauge

Atmospheric temperature minute = 17°C

Calorific value of gas = 19 MJ/m^3 at NTP

Rise in temperature of jacket cooling water= 45°C

Cooling water supplied = 180 kg

Draw up a heat balance sheet and estimate the indicated thermal efficiency and brake thermal efficiency. Assume atmospheric pressure as 760 mm of Hg.

6. (a) A two-cylinder four-stroke gas engine has a bore of 350 mm and a stroke of 575 mm. At 250 rpm the torque developed is 5.0 kN m. The air/fuel ratio is 8:1 by volume. The estimated volumetric efficiency is 85% and the calorific value of the coal gas is 16,800 kJ/m^3 Calculate: (a) bp (b) mean piston speed and (c) brake thermal efficiency of the engine. 10

(b) A single cylinder engine running at 1800 rpm develops a torque of 8 Nm. The indicated power of the engine is 1.8 kW. Find the loss due to friction power as the percentage of brake power. 5

(c) Describe in brief the necessity of engine cooling. Also write the disadvantages of overcooling. 5

Section–D

7. (a) Derive the expression for efficiency of gas turbine. Also find the optimum pressure ratio. 12

(b) Discuss the working of single stage reciprocating air compressor. Also derive their volumetric and isentropic efficiencies. 08

8. (a) Write the various methods of emission control. Also discuss various alternative fuels for IC engines. 12

(b) With neat sketch, explain the multistage compression with intercooling with regards to gas turbine plant. 8