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BT - 5 / D-19

I.C. ENGINE & GAS TURBINE

Paper-ME-301 N

Time allowed : 3 hours]

[Maximum marks : 75

Note:- Attempt five questions in all. Assume any missing data suitably.

1. (i) In what respects four stroke diesel cycle (CI) engine differs from four stroke cycle spark ignition engine? 7
(ii) A 4-cylinder four stroke petrol engine develops 14.7 kW at 1000 r.p.m. The mean effective pressure is 5.5 bar. Calculate the bore and stroke of the engine, if the length of stroke is 1.5 times the bore. 8
2. (i) Explain the deviation of actual cycle from the ideal cycle. 15
(ii) In a constant volume 'Otto cycle', the pressure at the end of compression is 15 times than at the start, the temperature of air at the beginning of compression is 38°C and maximum temperature obtained in the cycle is 1950°C. Determine:
(i) Compression ratio ✓
(ii) Thermal efficiency of the cycle.
(iii) Work done
Take γ for the air = 1.4
3. (i) Explain the effect of engine variables on ignition lag in SI engine. 7

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(2)

- (ii) Explain the ignition delay period in a diesel engine. 8.
4. (i) Explain the mixture requirement from no load to full load in S.I. engine. 7
(ii) Explain the various lubrication properties of the oil for an I.c. engine. 8
5. (i) Compare relative merits and demerits of air and water cooling systems. 6
(ii) Describe the various exhaust emissions from the S.I. Engine 9
6. During the trial of single acting oil engine, with cylinder diameter 200 mm stroke 280 mm, working on two stroke cycle and firing every cycle, the following observations were made: <http://www.kuonline.in> 15
Duration of trial = 1 hour, Total fuel used = 4.22 kg. Calorific value = 44670 kJ/kg, Proportion of hydrogen in fuel = 15%, Total number of revolutions = 21000, Mean effective pressure = 600 N, Total mass of cooling water circulated = 495 kg, Inlet temperature of cooling water = 13°C, Outlet temperature of cooling water = 38°C, Air used = 135 kg, Temperature of air in test room = 20°C and Temperature of exhaust gases = 370°C. Assume C_p for gases = 1.005 kJ/kg K, C_p for steam at atmosphere pressure = 2.093 kJ/kg K.
Calculate the thermal efficiency and draw up the heat balance sheet.

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7. (i) Derive the expression for the minimum work in two stage reciprocating air compressor. 7

(ii) A single stage, double acting compressor has a free air delivery of $14 \text{ m}^3/\text{min}$ measured at 1.013 bar and 15°C . The pressure and temperature in the cylinder during induction are 0.95 bar 32°C . The delivery pressure is 7 bar and index of compression and expansion, $n=1.3$. The clearance volume is 5% of the swept volume. Calculate (1) indicated power required (2) volumetric efficiency. 8

8. A gas turbine unit has a pressure ratio of $6:1$ and maximum cycle temperature of 610°C . The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/s . 15

Take $C_p = 1.005 \text{ kJ/kg K}$ and $\gamma = 1.4$ for the compression process and $C_p = 1.11 \text{ kJ/kg K}$ and $\gamma = 1.333$ for the expansion process.

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