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(REVISION — 2010)

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FOURTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING — MARCH, 2015

THERMAL ENGINEERING

[*Time* : 3 hours

(Maximum marks : 100)

PART—A

(Maximum marks : 10)

Marks

I Answer the following questions in one or two sentences. Each question carries 2 marks.

1. Describe open system.
2. Define air standard efficiency.
3. Define indicated power.
4. State Fourier law of conduction.
5. List any two advantages of multistage compressor. (5×2=10)

PART—B

(Maximum marks : 30)

II Answer *any five* of the following questions. Each question carries 6 marks.

1. Derive the expression for external work done during isothermal process.
2. A vessel of capacity $5m^3$ contains 20kg of ideal gas having a molecular weight of 25. If the temperature of gas is 15°C find the pressure.
3. State the assumptions made in air standard cycle.
4. Explain with neat sketch the working of four stroke diesel engine.
5. In a Diesel engine the compression ratio is 13 and cut-off ratio 2 find the air standard efficiency. Take γ 1.4.
6. Explain flash point, fire point and pour point temperature.
7. Explain Stefan-Boltzmann's law of total radiation. (5×6=30)

Marks

PART—C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT—I

III (a) Derive an expression for the work done during poly tropic process. 7

(b) Certain mass of gas having pressure, volume, temperature of 3 bar, 0.1m^3 and 200°C respectively. Its state changes until the temperature becomes 15°C at constant pressure, determine :

(i) The amount of heat transfer (ii) Work done during the process.

Take C_p = 1.005 kJ/kg-K, C_v = 0.718 kJ/kg-K. 8

OR

IV (a) Show that the characteristic gas constant $R = C_p - C_v$. 7

(b) An internal combustion engine cylinder has swept volume of .02 m^3 and the clearance volume is 0.0045 m^3. The pressure at the beginning of the expansion stroke is 16 bar and the expansion follows the law $pv^{1.3}$ = Constant. Determine :

(i) The pressure at the end of expansion stroke.

(ii) The external work done. 8

UNIT—II

V (a) Derive an expression for air standard efficiency of Diesel cycle and draw the PV diagram. 7

(b) The air standard efficiency of an engine working on Otto cycle is 51%. The temperature and pressure at the beginning of isentropic compression are 25°C and 1.5 bar respectively. Find :

(i) compression ratio (iii) pressure at the end of compression

(ii) temperature at the end of compression

Take γ = 1.4. 8

OR

VI (a) Draw the valve timing diagram of 4 stroke diesel engine. 7

(b) A carnot engine working between highest temperature 1000 K and 333 K. Find :

(i) Efficiency of engine.

(ii) External work done if the heat supplied was 240 kJ. 8

UNIT—III

VII (a) Explain Morse test. 7

(b) A four cylinder four stroke petrol engine has bore diameter 100 mm and 125 mm stroke length. It consumes 4 kg of fuel per hour having calorific value of 41160 kJ/kg and its indicated thermal efficiency is 40%. Find the crank speed. 8

OR

Marks

VIII (a) State essential requirements of a good fuel. 7

(b) A fuel has the following composition by mass. Carbon 80%, Hydrogen 14%, Oxygen 6%. Calculate the theoretical air supply required per kg of fuel and mass of product of combustion per kg of fuel. 8

UNIT—IV

IX (a) Explain free and forced convection. 7

(b) A brick wall 300 mm thick is faced with concrete 10 mm thick. If the temperature of the exposed brick face is 30°C and that of the concrete is 5°C. Thermal conductivity of concrete and brick are 0.93 W/m-K and 0.69 W/m-K, and the exposed surface area is $30m^2$ determine :

(i) Heat transfer rate (ii) Inter face temperature 8

OR

X (a) State the advantages of multistage compressors in air compressors. 7

(b) A compressor draws air at the rate of 42.5 m^3 per minute in to the cylinder at a pressure of 1.05 bar. It is compressed poly tropically ($pv^{1.3}$ = constant) to a pressure of 4.2 bar before being delivered to a receiver. Assuming a mechanical efficiency of 80%, find :

(i) Indicated power (ii) Shaft power 8