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DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/
MANAGEMENT/COMMERCIAL PRACTICE, APRIL-2020

APPLIED THERMODYNAMICS

[Maximum marks: 75] (Time: 2.15 Hours)

PART – A

(Answer any ***three*** questions in one or two sentences. Each question carries 2 marks)

I. (1). What do you understand by a thermodynamic process.

(2). Define available energy.

(3). What is meant by theoretic thermal efficiency.

(4). What are the methods for measuring engine speed.

(5). What are the mechanisms for heat transfer. (3 x 2 = 6)

PART – B

(Answer any ***four*** of the following questions. Each question carries 6 marks)

II. (1). Express in words the conservation of energy principle for a closed system.

(2). Derive the ideal gas equation of state.

(3). Explain how the thermodynamic cycles are classified.

(4). List out any five advantages of rotary compressor over reciprocating compressor.

(5). A single cylinder oil engine works on constant volume cycle has a compression ratio of 10 to 1. The specific fuel consumption is 0.6 kg/kWh. The calorific value of the fuel oil is 44000 kJ/kg. Calculate the thermal efficiency and relative efficiency. Take γ for air as 1.4

(6). How does forced convection differ from natural convection.

(7). Write short notes on thermal conductivity. (4 x 6= 24)

PART – C

(Answer ***any of the three units*** from the following. Each question carries 15 marks)

UNIT –I

III. (a). Describe the following terms.

(1). Boundary. (2). State. (3). Internal energy. (8)

(b). A quantity of gas is compressed according to $PV^{1.25} =$ constant. The initial temperature and pressure of the gas is 15^0C and 1 bar respectively. Find the work done in compressing 1kg of air at 3 bar and heat rejected through the walls of the cylinder. γ for air as 1.4, R = 311.4J/kgK. (7)

OR

IV. (a). Derive an expression for heat transfer, change in internal energy, work done and PVT relationship for a constant volume process. (8)

(b). A piston cylinder containing air expands at a constant pressure of 150 kPa from a temperature of 285 K to a temperature of 550 K. The mass of air is 0.05 kg. Find the heat transfer, work transfer and the change in internal energy during the process. Take Cp= 1 kJ/kg K and R = 0.287 kJ/kg K. (7)

UNIT-II

V. (a). Derive the expression for theoretical thermal efficiency of Cannot cycle. (8)

(b). In an ideal Otto cycle the air at the beginning of isentropic compression is at 1 bar and 15^0C. The ratio of compression is 8. If the heat added during the constant volume is 1000kJ/kg, determine the maximum temperature in the cycle and the air standard efficiency. Take γ for air as 1.4 and Cv = 0.718 kJ/kgK. (7)

OR

VI. (a).Compare the P.V and T.S diagrams of Otto and Diesel cycles. (8)

(b). An amount of a perfect gas has initial conditions of volume 1 m^3, pressure 1 bar and temperature 18^0C. It undergoes ideal diesel cycle operations, the pressure after isentropic compression being 50 bar and the volume after constant pressure heat addition being 0.1m^3. Calculate the temperatures after adiabatic compression and end of constant pressure heat addition. γ for air as 1.4. (7)

UNIT-III

VII. (a). List out any seven basic performance parameters of an internal combustion engine. (8)

(b). A 4-stroke petrol engine 80mm bore, and 100 mm stroke is tested at constant speed. The fuel supply is fixed at 0.068 kg/minute. And the plugs of the four cylinders are successively short circulated without change of speed. The brake power measurements are the following with all cylinders firing = 12.4 kW. With No 1 cut off = 9 W. With No 2 cut off = 9.15 kW. With No 3 cut off = 9.2 kW and No.4 cut off = 9.1 kW. Determine the indicated power of the engine. Also determine the indicated thermal efficiency. Calorific value of the fuel is 44100kJ/kg. Also determine the relative efficiency if the air standard efficiency is 56.85%. (7)

OR

VIII. (a). A gas engine working on 4 stroke constant volume cycle gave the following results during a test of an hour's duration.

Heat supplied by the fuel = 10280 kJ/min, indicated power = 20.8 kW, brake power = 18400 W, mass of cooling water circulated = 660 kg/h, cooling water temperature rise = 34.2^0C. Heat loss to exhaust gas = 8%. Prepare a heat balance sheet for the engine. (8)

(b). Describe the working of a two-stage reciprocating air compressor. (7)

UNIT-IV

IX. (a). Briefly mention about absorptivit, transmissivity and reflectivity. (7)

(b). Explain Fourier's law heat conduction and Newtons law of cooling. (8)

OR

X. (a). Briefly explain about counter flow and cross flow type heat ex-changers. (8)

(b). A furnace wall is built with 200mm thick refractory bricks and 150 mm insulating bricks. The temperature of the surrounding is 40^0C whereas that inside the furnace is 1000^0 C. The thermal conductivities of the refractory bricks and insulating bricks are 5 W/mk and 0.5 W/mk respectively. Determine the heat loss per square metre per minute. (7)