7457

BOARD DIPLOMA EXAMINATION, (C-20)

MAY—2023

DME - FOURTH SEMESTER EXAMINATION

HEAT POWER ENGINEERING—I

Time : 3 Hours] [*Total Marks* : 80

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed five simple sentences.

1. Define *(a)* fuel and *(b)* combustion of fuel. 1½+1½

2. Write the combustion chemical equations for *(a)* carbon and *(b)* hydrogen. 1½+1½

3. State three differences between 2-stroke and 4-stroke IC engines. 3

4. Draw the theoretical valve timing diagram for 4-stroke CI engines. 3

5. Write the significance and limitations of Morse test. 1½+1½

6. Define the terms *(a)* indicated power and *(b)* brake power related to IC engines. 1½+1½

7. List out any three advantages of multistage compression. 1+2

8. State essential differences between reciprocating and rotary air compressors. 3

9. List out two limitations of gas turbines. 3

10. Write any three applications of jet engines. 3

PART—B

8×5=40

Instructions : (1) Answer **all** questions.

(2) Each question carries **eight** marks.

(3) Answers should be comprehensive and criterion for valuation is the content but not the length of the answer.

11. *(a)* Describe the working of Orsat's apparatus with a line diagram. 4+4

(OR)

(b) The volumetric analysis of a flue gas is CO_2 = 15%, CO = 2%, O_2 = 2%, N_2 = 81%. The composition of fuel is C = 82%, H_2 = 16%, O_2 = 2%. Find *(i)* the mass of carbon per kg of flue gas and *(ii)* the mass of flue gas per kg of fuel. 5+3

12. *(a)* What is the necessity of lubrication system in IC engines? Explain pressurized lubricating system in IC engines with a neat sketch. 2+3+3

(OR)

(b) Explain the working principle of 2-stroke SI engine with a legible sketch. 8

13. *(a)* A four-cylinder IC engine develops a brake power of 51.45 kW at 2000 r.p.m. A Morse test carried out records the brake torque readings as 179.7 N-m, 172.8 N-m, 170 N-m and 177 N-m. Calculate I.P, F.P and mechanical efficiency of the engine. 3+2+3

(OR)

(b) A four cylinder, two-stroke cycle SI engine develops 30 kW at 2500 r.p.m. The mean effective pressure of each cylinder is 800 kN/m^2 and mechanical efficiency is 80%. Calculate the *(i)* diameter, *(ii)* stroke of each cylinder if stroke to bore ratio is 1.5 and *(iii)* brake specific fuel consumption of the engine if brake thermal efficiency is 28%. Calorific value of fuel = 44000 kJ/kg. 3+2+3

14. *(a)* Explain the working of a centrifugal air compressor with a neat sketch. 4+4

(OR)

(b) The A two-stage air compressor is used to compress 1 kg of free air from 1 bar and 32 °C to 26 bar. The value of n = 1.33 and R = 0.287 kJ/kg-K. Determine *(i)* the intermediate pressure; *(ii)* work required for the best performance; *(iii)* work for a corresponding single-stage compressor and *(iv)* percentage saving in work in two-stage compressor. 2+2+2+2

15. *(a)* Explain the working of open cycle gas turbine with a line diagram. 4+4

(OR)

(b) Explain the working of rocket engine with a line diagram. 4+4

PART—C

10×1=10

Instructions : (1) Answer the following question.

(2) The question carries **ten** marks.

(3) Answer should be comprehensive and the criterion for valuation is the content but not the length of the answer.

16. Analyse the following data of an IC engine :

Single cylinder engine developing one power stroke in two revolutions of the crank shaft;

Mean height of indicator diagram	=	27 mm;
Indicator spring constant	=	21 kN/m^2/mm;
Swept volume of cylinder	=	14 liters;
Speed of the engine	=	396 r.p.m.;
Effective brake load	=	77 kg;
Effective brake radius	=	70 cm;
Fuel consumption	=	0.0025 kg/sec;
Calorific value of fuel	=	35200 kJ/kg;
Cooling water circulated	=	0.15 kg/sec;
Inlet and outlet temperatures of cooling water	=	40 °C and 73 °C;
Specific heat of water	=	4.2 kJ/kg-K.;
Energy lost to exhaust gases	=	32 kJ/sec.

Determine *(a)* mechanical efficiency and *(b)* draw up the heat balance sheet. 4+6

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