C09-M-305

3249

BOARD DIPLOMA EXAMINATION, (C-09)

OCT / NOV-2015

DME - THIRD SEMESTER EXAMINATION

THERMAL ENGINEERING – I

Time : 3 hours] [Total Marks : 80

PART - A

3 X 10 = 30

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

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

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

1. State the limitations of first law of thermodynamics.

2. Show that $C_p - C_v = R$ for an ideal gas?

3. Write down the difference between free expansion process and throttling process.

4. One kg of air at 1 bar and 27° C compressed polytropically to a pressure of 15 bar and air temperature rises to 227° C. Determine the polytropic index.

5. Write any three limitations of gaseous fuels.

6. What do you understand by minimum air and excess air in the context of combustion?

7. Write down the effects of compression ratio and cut-off ratio on the ideal efficiency of Diesel cycle.

8. State the principle of throttling calorimeter.

9. Show that the enthalpy drop is equal to the change of internal energy in hyperbolic process.

10. Mention any six applications of refrigeration.

PART - B

10 X 5 = 50

Instructions : (1) Answer any **five** questions.
(2) Each question carries **ten** marks.
(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. Write down the general energy equation for steady flow system and simplify when applied for the following systems :
(i) Centrifugal water pump *(ii)* Reciprocating air compressor
(iii) Steam nozzle *(iv)* Steam turbine and (v) Boiler

12. *(a)* Define ideal gas. How does a real gas differ from an ideal gas? When the relation $PV = MRT$ expected to be applicable
(b) Derive an expression for air standard efficiency of Otto cycle in terms of compression ratio.

13. One kg of perfect gas at a pressure of 30 bar and temperature of 1000°C expands in a cylinder to a volume five times the original volume. Find the final temperature, work done and heat interchange if the expansion process is *(i)* isothermal, *(ii)* $PV^{1.25}$ = constant and *(iii)* adiabatic.
Assume $C_p = 2.127$ kJ/kg-K and $C_v = 1.671$ kJ/kg-K.

14. a) Explain the physical significance of entropy. What is its importance in thermodynamics?
b) A constant volume chamber of 0.3 m^3 capacity contains 2 kg of the above gas at 5°C. Heat is transferred to the gas until the temperature is 100°C. Find the gas molecular mass, gas constant and the change in entropy. Assume $C_p = 1.97$ and $C_v = 1.51$ kJ/kg-K.

15. Describe with the help of neat sketch the junkers gas calorimeter used for the determination of heating values of gaseous fuels.

16. An engine working on Carnot cycle operates between the temperature limits T_1=900 K and T_2 = 300 K, and between pressure limits 60 bar and 1 bar with one kg of air. Find *(i)* pressures and volumes at each salient point of the cycle, *(ii)* work done and efficiency and *(iii)* sketch the processes on *p-V* and *T-s* diagrams.
Assume $\gamma = 1.4$, $R = 0.287$ kJ/kg-K.

17. 1 m^3 of steam at 2 bar and 40% wet is compressed to 10 bar according to the law $pV^{1.2} = C$. Find *(i)* the final volume and dryness fraction, *(ii)* the work done during compression, *(iii)* the change of enthalpy per kg of steam and *(iv)* the heat transfer per kg of steam. Negelct the volume of water.

18. a) State the differences between open-air systems and closed-air systems of Bell-Coleman refrigerator.
b) Explain any two methods of refrigeration.

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