Roll No. | | | | | | | | | | | | | Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(Marine Engineering) (2013 Onwards) (Sem.–4)

APPLIED THERMODYNAMICS – II

Subject Code : BTME-404

Paper ID : [72437]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Why is an external power input needed to drive compressor?

b) What is the principle of operation of the reciprocating compressor valve?

c) What do you mean by diffuser efficiency? Write expression.

d) What do you mean by root blower?

e) What do you mean by slip factor in centrifugal compressor? Write expression.

f) Discuss choking phenomenon.

g) Axial compressor is more preferred than centrifugal compressor in aviation. Give reasoning.

h) What are the methods of improving the thermal efficiency of simple open cycle gas turbine?

i) Is it true that rocket is independent of atmospheric air? Give reasons.

j) What do you mean by propulsive power and propulsive efficiency?

SECTION-B

2. How will you classify compressors? Differentiate between the working principles of positive displacement and dynamic compressors.

3. A single acting 14 cm × 10 cm reciprocating air compressor having 4 % clearance gives the following data obtained from a performance test. Suction pressure, 0 bar gauge, Suction temperature 20°C, barometer 76 cm Hg, discharge pressure 5 bar gauge, discharge temperature 180°C. Speed 1200 rpm, Shaft power 6.247 kW, mass of air delivered 1.7 kg/min. Calculate:

   (a) The actual volumetric efficiency

   (b) Indicated power

   (c) Isothermal efficiency

   (d) Mechanical efficiency

   (e) Overall isothermal efficiency

4. Discuss working of screw compressors with the help of neat sketch.

5. Derive the expression

$$W = \frac{C_2^2 - C_1^2}{2} + \frac{C_{r1}^2 - C_{r2}^2}{2} + \frac{u_2^2 - u_1^2}{2}$$

   In case of centrifugal compressors and explain its physical significance.

6. Show the various thermodynamic processes in axial flow compressors on h-s chart.

SECTION-C

7. A compressor running at 9000 *rpm* delivers 600 m^3/min of free air. The air is compressed from 1 bar and 20°C to a pressure ratio of 4 with an isentropic efficiency of 0.82. Blades are radial at outlet of impeller and the flow velocity of 62 m/s may be assumed throughout constant. The outer radius of the impeller is twice the inner radius and the slip factor and blade area coefficient at inlet may be assumed as 0.9. Calculate:

   (a) Final temperature of air

   (b) theoretical power

   (c) impeller diameter at inlet and outlet

   (d) breadth of impeller at inlet

   (e) impeller blade angle at inlet

   (f) diffuser blade angle at inlet

8. Derive an expression for the optimum pressure ratio giving maximum cycle thermal efficiency of the gas turbine cycle, if the compressor efficiency if η_c and turbine efficiency is η_t. The maximum cycle temperature is T_3 and the minimum cycle temperature is T_1.

9. A jet propelled unit travels at 180 m/s in air at 0.65 bar and – 6°C. Air first enters diffuser in which it is brought to rest relative to the unit and it is then compressed in a compressor through a pressure ratio of 5.8 and fed to a turbine at 925 °C. The gas expands through the turbine and then through the nozzle to atmospheric pressure (*i.e.* 0.65 bar). The efficiency of diffuser and nozzle are 0.9.The compressor and turbine efficiencies are 0.8. Pressure drop in the combustion chamber is 0.14 bar. Find the fuel-air ratio and the specific thrust of the unit. If the inlet cross-section of the diffuser is 0.1 m^2, calculate the total thrust. Assume calorific value of fuel as 44141 kJ/kg of fuel.