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Total No. of Questions : 09

B.Tech.(AE) (2011 Onwards) (Sem.–3)
# APPLIED THERMODYNAMICS
Subject Code : BTAE-302
Paper ID : [A1115]

Time : 3 Hrs.   Max. Marks : 60

INSTRUCTION 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) Represent isothermal, isentropic and polytropic compression process on P-V diagram.

   b) Write formula for indicated power for single acting and double acting reciprocating compressor.

   c) What is effect of clearance on volumetric efficiency in reciprocating compressor?

   d) What is function of diffuser in centrifugal compressor?

   e) For which requirements, centrifugal compressors are used?

   f) Define degree of reaction in axial flow compressors.

   g) Draw ideal and actual cycle for gas turbine on T-S diagram.

   h) Define cycle air rate in gas turbine.

   i) Write two advantages of jet propulsion system.

   j) Write basic difference between turbojet and turboprop.

SECTION-B

2) Explain construction and operation of positive displacement rotary compressor with help of neat sketch.

3) Define slip factor and derive expression for the same.

4) Describe stalling in axial flow compressors. Does it affect axi-symmetric flow in compressor?

5) A turbojet aircraft flies with a velocity of 300m/s at an altitude where the air is at 0.35 bar and –40°C. The compressor has a pressure ratio of 10, and the temperature of gases at the turbine inlet is 1100°C. The air enters the compressor at a rate of 50 kg/s. Estimate

    (a) the temperature and pressure of the gases at the turbine exit,

    (b) the velocity of gases at the nozzle exit, and

    (c) the propulsive efficiency of the cycle.

6) Discuss centrifugal compressor characteristic curves.

SECTION-C

7) A single-stage double acting air compressor has a stroke volume of 0.056 m^3 and a clearance volume of 0.0028 m^3. Find the volumetric efficiency and the mass of air delivered per hour when the speed is 200 rev/min, the suction pressure and temperature 0.9 bar and 50 °C, respectively, and the delivery pressure 6 bar. Determine also the indicated power to drive the compressor. Assume the law of compression and re-expansion is $pV^{1.35}$ = constant.

8) A centrifugal compressor compresses 30 kg of air per second at a rotational speed of 15000 *rpm*. The air enters the compressor axially, and the conditions at the exit sections are radius-0.3m; relative velocity of air at the tip-100m/s at an angle of 80°C.

    Find the torque and power required to drive the compressor and also the ideal head developed.

9) Prove that the efficiency corresponding to the maximum work done in a Brayton cycle is given by the relation :

$$\eta_{w\max} = 1 - \frac{1}{\sqrt{t}}$$

    where *t* is the ratio of the maximum and minimum temperature of the cycle. A gas turbine operating on Brayton cycle between 27 °C and 827 °C. Determine the maximum network per kg and cycle efficiency.