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B.Tech.(Aerospace Engg.) (2012 Onwards)   (Sem.–5)
AEROSPACE PROPULSION-II
Subject Code : ASPE-305
Paper ID : [A2931]

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) **Answer in short :**

a) Write the static-to-static efficiency equation of a turbine.

b) What is the mass flow rate through the core of the bypass engine if the total mass flow entering the engine is 48 kg/s and the bypass ration is 5?

c) What are the difference between a ram jet and a scram jet engine?

d) Thrust equation is given by $T = m(V_e – V_\infty) + A(P_e - P_\infty)$. Consider a situation where there is no nozzle attached to the engine and the turbine exhaust is at the same velocity as the vehicle speed. This situation results in higher pressure at the engine exit, and so the thrust produced is positive in this case. The advantage of this case is that there is no added weight due to the nozzle. Why is this technique not followed in reality? What are the advantages and disadvantages of this technique?

e) What are the differences between turbo prop and turbo shaft engines?

f) Under what condition is the nozzle is said to be operating in over expanded condition?

g) Write the equation for degree of reaction in terms of temperature.

h) Draw the velocity diagram of a turbine with 50% reaction and mention the velocity conditions prevails for the same.

i)   State any two methods to reduce the length of the rocket nozzle.

j)   What is a flame tube? What is the necessity to cool the same?

SECTION-B

2)   Explain the Otto cycle with neat diagram.

3)   Explain the factors affecting thrust of a gas turbine engine.

4)   Obtain Area-Velocity relation.

5)   Explain the phenomenon of rotor stall with neat sequential diagrams.

6)   Briefly discuss any 5 nozzle types used in rocket propulsion with neat diagram.

SECTION-C

7)   A CD duct has to be designed to accelerate the flow to 3 Mach. The duct outlet is open to atmosphere. The constraint is that the high pressure storage tank can supply high pressure air only at 0.5 kg/s continuously at the required pressure to complete the experiment. Calculate the throat area A*and exit area of the duct. Note: the tank and the air contained are in equilibrium with the ambience which is at 303 K. What is the static temperature and static pressure at the throat and the exit? Take the ambient pressure to be 101325 Pascal.

8)   Explain any 5 factors affecting the combustor design in detail.

9)   Combustion gases enter the first stage of a gas turbine at a stagnation temperature and pressure of 1200K and 4.0 bar. The rotor blade tip diameter is 0.75 m, the blade height is 0.12m and the shaft speed is 10 500 rev/min. At the mean radius the stage operates with a reaction of 50 percent, a flow coefficient of 0.7 and a stage loading coefficient of 2.5. Determine :

a)   The relative and absolute flow angles for the stage.

b)   The velocity at nozzle exit.