**Reg. No. \_\_\_\_\_\_\_\_**

**Karunya University**

**(Karunya Institute of Technology and Sciences)**

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

**Supplementary Examination - June 2011**

**Subject Title: PROPULSION ENGINEERING Time: 3 hours**

**Subject Code: 09ME316 Maximum Marks: 100**

**Answer ALL questions (5 x 20 = 100 Marks)**

1. **Compulsory**:

In a turbojet engine with forward facing ram intake, the jet velocity relative to the propelling nozzle at exit is twice the flight velocity. Determine the rate of fuel consumption in kg/s, When developing a thrust 25000 N under the following conditions.

Ambient pressure and Temperature : 0.7bar and 1°C

Compression ratio : 5:1

Flight velocity : 800km/hr

CV of fuel : 42000 kJ/kg

Ram efficiency : 100%

Isentropic efficiency of compressor : 85%

Isentropic efficiency of Nozzle : 95%

Isentropic efficiency of turbine : 90%

Combustion efficiency : 98%

Turbine pressure ratio : 2.23

Assume the mass flow of fuel is small compared with the mass flow of air and that the working fluid throughout has the properties of air at low temperature. Neglect the extraneous pressure drop. Assume Cpg= Cpa =1.005kJ/kg K.

2. a. Explain the principle operation of a centrifugal compressor with a neat sketch. (10)

b. Derive the equation for actual work done and the overall stagnation pressure ratio of a centrifugal compressor. (10)

(OR)

3. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45°and 10° respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is 37° C.The blade speed and axial velocity are constant throughout the compressor. Assuming a value of 200 m/s for blade speed find the number of stages required if the work done factor is (i) Unity and (ii) 0.87 for all stages.

4. a. List requirements of a combustion chamber. (8)

b. Describe briefly the factors affecting the combustion chamber design. (8)

c. List the difference between Impulse and Reaction Turbine . (4)

(OR)

5. a. Gas with a velocity of 240 m/s relative to blades enters an impulse moving row at an angle of 60° with respect to axial direction. The tangential velocity of blade is 183 m/s. The work developed in blades is estimated as 75 kJ/ kg of gas. Find the blade efficiency and the blade friction coefficient for relative velocities. Assume symmetrical blades. (12)

b. Explain the methods used for turbine blade cooling. (8)

[P.T.O]

6. a. Explain the starting problems of supersonic inlets. (7)

b. Explain the variable geometry inlet for supersonic aircraft with neat sketch. (7)

c. Explain thrust vectoring. (6)

(OR)

7. a. Discuss the various thrust augmentation methods used in aircraft. (12)

b. Explain the types of combustion chamber used in aircraft engine with their advantages and disadvantages. (8)

8. a. Explain the matching procedure of a single spool turbo jet engine. (10)

b. Explain the performance evaluation of Single –spool turbojet engine. (10)

(OR)

9. The following data refer to a single-shaft gas turbine operating at its design speed

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Compressor characteristic | | | Turbine characteristic | |
|  |  |  |  |  |
| 5.0 | 329 | 0.84 | 139.0 | 0.87 |
| 4.5 | 339 | 0.79 | 139.0 | 0.87 |
| 4.0 | 342 | 0.75 | 139.0 | 0.87 |

Assuming ambient conditions of 1.013 bar and 288 K, a mechanical efficiency of 98%, and neglecting all pressure losses, calculate the turbine inlet temperature required for a power output of 3800 kW.