No. of Printed Pages : 5

BAS-016

B.TECH. (AEROSPACE ENGINEERING) (BTAE)

Term-End Examination

December, 2013

00208

BAS-016 : PROPULSION - II

Time : 3 Hours *Maximum Marks : 70*

Note : *Attempt **any seven** questions. All questions **carry equal** marks. Use of scientific calculator and steam tables is **permited**.*

1. (a) State the fundamental difference between the turbo - jet engine and turboprop engine.

3+7=10

(b) The following data pertain to a turbo - jet flying at an altitude of 9500 m.

Speed of turbo - jet = 800 km/hr

Propulsive Efficiency = 55%

Over all efficiency of the turbine plant = 17%

Density of air at 9500 m altitude = 0.17% kg/m^3.

Drag on the plane = 6100 N

Assuming calorific value of the fuel used as 46000 kJ/kg.

Calculate :

(i) Absolute velocity of the jet

(ii) Volume of air compressed per min

(iii) Diameter of the jet

(iv) Power output of the unit

(v) Air - fuel ratio

2. (a) What do you understand by the term ignition ? **3+7=10**

(b) A turbo - jet engine flying at a speed of 960 km/hr consumes air at the rate of 54.5 kg/s

Calculate :

(i) Exit velocity of jet when the enthalpy change for the nozzle is 200 kJ/kg and velocity co-efficient is 0.97.

(ii) Fuel flow rate in kg/sec when air-fuel ratio is 75 : 1.

(iii) Thrust specific fuel consumption

(iv) Thermal efficiency of the plant when the combustion efficiency is 93% and calorific value of the fuel is 45000 kJ/kg.

(v) Propulsive power

(vi) Propulsive efficiency

(vii) Overall efficiency

3. (a) What is a nozzle and a diffuser ? **3+7=10**

(b) A stream of air flows in a duct of 100 mm diameter at a rate of 1 kg/s. The stagnation temperature is 37°C. At one section of the duct the static pressure is 40 kPa. Calculate the Mach number, velocity and stagnation pressure at this section.

4. (a) What is a shock ? Where does it occur in a nozzle ? **3+7=10**

(b) Prove that for a one - dimensional steady isentropic flow through nozzle.

$$\frac{dA}{A} = \left(M^2 - 1\right)\frac{dV}{V}$$

Where symbols carries usual meaning

5. (a) What are the main applications of compressors ? **3+7=10**

(b) An axial flow compressor was tested and found that it gave a pressure rise of 3 atmospheric and a temperature rise of 125°C. A 2000 kW motor was used to drive the compressor. Determine the compressor efficiency and the mass flow of air delivered, if the mechanical efficiency to be 95% and pressure and temperature at inlet were 1 atm and 300 K respectively.

Assume $\gamma = 1.4$.

6. (a) Explain the principle of jet propulsion and mention how the jet propulsion engines are classified. 3+7=10

(b) With the aid of a neat diagram, explain the working principle of Ramjet engines.

7. (a) What are the advantages and disadvantages of a ramjet engine and what are its applications ? 3+7=10

(b) What is meant by thrust ? Derive the thrust equation for a general propulsion system.

8. (a) Explain in detail the combustion theory applied to a gas turbine combustion system.

(b) Air enters an axial flow compressor at 1 bar and 20°C at low velocity. It is compressed through a pressure ratio of 11. Find the final temperature and pressure at outlet from the compressor. Take the compressor efficiency as 85%. 3+7=10

9. (a) Explain the process of combustion in a gas turbine combustion chamber. 3+7=10

(b) What do you understand by blade and stage efficiency ? Derive an expression for blade efficiency.

10. (a) How do you differentiate between an impulse and a reaction turbine ? With neat sketches explain the working of an impulse and a reaction stage. **3+7=10**

(b) In a single - stage impulse turbine the nozzle discharges the hot gas on to the blades at a velocity of 750 m/s. The mass flow rate of gas is 100 kg/sec. The turbine rotates at 20000 rpm. The mean diameter of wheel is 31.5 cm. The nozzles are inclined at an angle of 20° to the plane of wheel rotation.

Calculate :

(i) power developed by the blades,

(ii) energy lost in the blades per second, and

(iii) determine the maximum efficiency of the turbine.

Assume the blade velocity co-efficient as 0.92 and outlet blade angle as 25°.