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BAS-016

B.TECH. (AEROSPACE ENGINEERING) (BTAE)

Term-End Examination

June, 2013 00594

BAS-016 : PROPULSION - II

Time : 3 Hours *Maximum Marks : 70*

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

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1. (a) State the fundamental difference between the jet propulsion and rocket propulsion.

(b) A turbo - jet engine consumes air at the rate of 60.2 kg/sec when flying at a speed of 1000 km/hr. **3+7=10**

Calculate :

(i) Exit velocity of the jet when the enthalpy change for the nozzle is 230 kJ/kg and velocity co - efficient is 0.96.

(ii) Fuel flow rate in kg/sec when air - fuel ratio is 70 : 1

(iii) Thrust specific fuel consumption.

(iv) Thermal efficiency of the plant when the combustion efficiency is 92% and calorific value of the fuel used is 42000 kJ/kg.

(v) Propulsive power
(vi) Propulsive efficiency and
(vii) Overall efficiency

2. (a) What are the advantages of burning overall fuel - air mixture ? **3+7=10**

(b) A turbo - jet has a speed of 750 km/hr while flying at an altitude of 10000m. The propulsive efficiency of the jet is 50% and overall efficiency of the turbine plant is 16%. The density of air at 10000m altitude is 0.173 kg/m^3. The drag on the plane is 6250 N. The calorific value of the fuel is 48000 kJ/kg.

Calculate :

(i) Absolute velocity of the jet.
(ii) Volume of air compressed per minute
(iii) Diameter of the jet.
(iv) Power output of the unit in kW.
(v) Air - Fuel ratio.

3. (a) What are the purposes of lubrication in jet engines ? **3+7=10**

(b) Air at P_o = 1.4bar, T_o = 280 K expands isentropically through a converging nozzle and discharges to the atmosphere at 1bar. The exit plane area is 0.0013 m^3. Determine the mass flow rate. Is it possible to increase the mass flow rate by increasing the supply pressure ?

4. (a) What do you understand by choking in nozzle flow ? 3+7=10

(b) Show that the discharge through a nozzle is maximum when there is a sonic condition at its throat.

5. (a) What is the function of a compressor ? What are the different types of compressors ? 3+7=10

(b) A turbojet engine is travelling at 920 km/hr at standard sea level conditions. The ram efficiency is 87%, the compressor pressure ratio is 4 : 3 : 1, the compressor efficiency is 82%, the burner pressure coefficient is 2%, the fuel - air ratio is 0.0119, the turbine inlet temperature is 688°C. The turbine efficiency is 83.5% and equivalent jet efficiency is 96%.

Calculate :

(i) the specific gross thrust, and

(ii) the thrust specific fuel consumption.

Assume C_{pa} = 1.005 kJ/kgK and γ_a = 1.4, C_{pg} = 1.147kJ/kgK and γ_g = 1.33, T_a = 18°C and P_a = 1 bar.

6. (a) Define the volumetric efficiency of a compressor. On what factors does it depend ? 3+7=10

(b) The exit velocity from a jet unit is 650 m/sec for an air flow of 40 kg/sec through the unit. The aircraft is flying at 250 km/hr. Calculate the thrust developed; the thrust power and the propulsion efficiency. Neglect the effect of fuel.

7. (a) Why diffusers are necessary in a centrifugal compressor ? **3+7=10**

(b) A centrifugal compressor under test gave the following data :
speed : 11500 rpm
Inlet total head temperature : 21° C.
Outlet total head pressure : 4 bar
Air flow : 131600 kg/hr.
Impellor diameter : 75 cm
If the slip factor is 0.92, What is the compressor efficiency ?

8. (a) What are the basic requirements of compressors for aircraft applications ? Do axial flow compressors meet them ? Explain. **3+7=10**

(b) A 10 stage axial flow compressor provides an overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. When the temperature of air at inlet is 15°C. The work is equally divided between the stages. A 50% reaction is used with a blade speed of 210 m/sec and a constant axial velocity of 170 m/s . Estimate the blade angle. Assume a work done factor of 1.

9. (a) What are the various factors which effect the combustion chamber performance ? Explain. **3+7=10**

(b) Find the required air - fuel ratio in a gas turbine whose turbine and compressor efficiencies are 85% and 80% respectively. Maximum cycle temperature is 875°C. The working fluid can be taken an air (C_p = 1.0 kJ/kgK, γ = 1.4) Which enters the compressor at 1 bar and 27°C. The pressure ratio is 4. The fuel used has calorific value of 42000 kJ/kg. There is a loss of 10% of calorific value in the combustion chamber.

10. Write short notes on ***any five*** of the following : **5x2=10**

(a) Flame tube cooling

(b) Fuel injection

(c) Pollution in combustion system

(d) Knocking

(e) Nozzle coefficient

(f) Afterburner

(g) Air - fuel ratio

(h) Blade cooling