Code No: NR322103 **NR**

III B.Tech II Semester Supplementary Examinations,
November/December 2005
AEROSPACE PROPULSION-II
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) In what way the gas turbine cycles can be grouped and what are the important distinctions between them. Further express net work done of an open cycle in terms of temperatures using p-V and T-s plot?

   (b) A closed cycle gas turbine (with reheat) power plant operates using helium as the working medium. The pressure ratio is 10. The maximum permitted temperature is 1000 K. Assuming the work output to be maximum, calculate the efficiency. If air is used instead of helium, calculate the efficiency and difference in heat added. Assume ideal Brayton cycle. Temperature at the inlet of compressor = 27^0 C; C_p and γ values for helium are 5.204 kJ/kg-K and 1.65, respectively. [8+8]

2. (a) Explain the performance characteristics of Turbojet engine. Discuss variation of thrust and SFC with flight conditions for a given engine?

   (b) Air enters a turbojet engine at a rate of 12 x 10^4 kg/hr at 15^0 C and 1 bar and is compressed adiabatically to 1800^0 C and four times the pressure. Products of combustion enter the turbine at 815^0 C and leave it at 650^0 C to enter the nozzle. Calculate the isentropic efficiency of the compressor, the power required to drive the compressor, the exit speed of gases and thrust developed when flying at 800 kmph. Assume the isentropic efficiency of turbine is same as that of the compressor and the nozzle efficiency 90%. [8+8]

3. A gas with a velocity of 300 ms^{-1} is flowing through a horizontal pipe at a section where pressure is 6 x 10^4 Nm^{-2} (absolute) and temperature 40^0 C. The pipe changes in diameter and at this section the pressure is 9 x 10^4 Nm^{-2}. Find the velocity of the gas at this section if the flow of the gas is adiabatic. Take R = 287 J/kg-K and $\gamma = 1.33$. [16]

4. A delaval nozzle has to be designed for an exit Mach number of 1.5 with exit diameter of 200 mm. Find the ratio of throat area/exit area necessary. The reservoir conditions are given as $p_o = 1$ atm, $T_o = 20^0$ C. Also find the maximum mass flow rate through the nozzle and the exit pressure and temperature. [16]

5. (a) Draw a schematic diagram of a pulse jet engine and describe its operation. What are the advantages and disadvantages of pulse jet engine?

   (b) Define ram efficiency and derive an expression for it. Explain how ram rocket combines the desirable characteristics of a rocket and a ramjet? [8+8]

6. A ramjet has following data: Altitude = 6.5 km, Flight Mach number = 4 , Air fuel ratio = 50, Calorific value of the fuel used = 45 MJ/kg, Diffuser inlet diameter = 0.5 m, $\gamma = 1.4$ and R = 287 J/kg-K for both air and the products of combustion. Efficiencies of the diffuser, combustor and the nozzle are 0.85, 0.98 and 0.95 respectively. Determine the following:
   (a) Ideal cycle efficiency
   (b) Flight speed
   (c) Air and fuel consumptions
   (d) Diffuser pressure ratio
   (e) Maximum temperature in the engine
   (f) Nozzle pressure ratio and exit mach number
   (g) Thrust
   (h) Air specific impulse [16]

7. (a) Describe briefly six important applications of rocket propulsion?
   (b) Draw a simple sketch of a "PSLV" depicting clearly the following:
      i. The Booster stage
      ii. Propellant tanks and exhaust nozzles
      iii. Instrument and Navigational equipment and
      iv. The spacecraft or payload bay
      v. Number of stages with respective solid and liquid engines [6+10]

8. (a) Briefly describe the rocket developed by Indian space research organization (ISRO) and state four rocket vehicles developed by ISRO.
   (b) Explain the terms orbital and escape velocity. Further, Calculate the orbital and escape velocities of a rocket at mean sea level and an altitude of 300 Km from the following data:
      i. Radius of earth at mean sea level = 6400 km
      ii. Acceleration due to gravity at mean sea level = 9.81 ms^{-2} [8+8]

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