B.E. (Aeronautical Engineering) Semester Fifth (C.B.S.)

Propulsion - I

Paper - V

P. Pages : 2 **KNT/KW/16/7374**

Time : Three Hours * 0 6 8 5 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) Explain the effect of temperature, altitude and air speed on turbine thrust. **6**

b) What are the various parts of turboprop engine ? Explain the working of turboprop engine with its thermodynamic cycle & performance. **8**

OR

2. A jet propelled plane consuming air at the rate of 18.2 kg/s is to fly at mach. no. 0.6 at an altitude of 4500 m (Pa = 0.55 bar Ta = 255 K). **14**
The diffuser which has a pressure coefficient of 0.9 decrease the flow to a negligible velocity. The compressor pressure ratio is 5 & max. temperature in the combustion chamber is 1273 k. After expanding in the turbine, the gases continue to expand in the nozzle to a pressure of 0.69 bar. The isentropic efficiency of compressor turbine & nozzle are 0.81, 0.85 & 0.915 respectively. The heating value of fuel is 45870 kJ/kg. Assuming $C_{pa} = 1.005\ kJ/kg.k$, $C_{pg} = 1.147\ kJ/kg.k$, $\gamma_{air} = 1.4$, $\gamma_{gas} = 1.33$. Calculate :

i) Power input to the compressor.
ii) Power output of the turbine
iii) The fuel air ratio
iv) The thrust provided by the engine
v) The thrust power developed.

3. a) What is Re-heat cycle of gas turbine engine ? Draw its block diagram & P-V & T-S plot. Find the expression for maximum efficiency for Re-heat cycle. **9**

b) Write the assumption for actual gas turbine engine. **4**

OR

4. a) Briefly explain the supersonic inlets. **6**

b) What is the purpose of an aircraft gas turbine inlet & nozzle ? Briefly explain inlets. **7**

5. a) Compare the can, Angular and can-angular combustion chamber on the basis of their advantages and disadvantages. **6**

b) Explain the factor affecting combustion chamber design. **7**

OR

6. Write short notes on : **13**

i) Combustion process. ii) Blow out

iii) Flame tube cooling iv) Fuel injector

7. a) Derive the expression for mass flow rate through nozzle in terms of Mach number. Also find out the expression for max. mass flow rate. **8**

b) What is the difference between static state & stagnation state ? Find out the relationship between static & stagnation density for isentropic flow through nozzle. **5**

OR

8. a) Explain nozzle chocking. **6**

b) Explain the effect of back pressure on the flow through C.D. nozzle. **7**

9. a) What is degree of reaction for axial flow compressor ? Find the expression for degree of reaction. What is the condition for 50% degree of reaction ? **8**

b) A centrifugal compressor has to deliver 35 kg of air per second. The impeller is 76 cm diameter at 11500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2:1, estimate the probable axial width of the impeller of the impeller tip if the radial velocity is 120 m/s. The inlet condition are 1 bar and 47ºC. **6**

OR

10. Air at 1.0132 bar and 288 k enters an axial flow compressor stage with an axial velocity 150 m/s. There are no inlet guide vanes. The rotor stage has a tip diameter of 60 cm and a hub diameter of 50 cm and rotates at 100 rps. The air enters the rotor and leave the stator in the axial direction with no change in velocity or radius. The air is turned through 30.2º as it passes through rotor. Assume a stage pressure ratio of 1.2. Assuming constant specific heat and that the air enters and leave the blade at the blade angles. **14**

i) Construct velocity diagram at mean dia. For this stage.
ii) Mass flow rate
iii) Power required and
iv) Degree of reaction.

11. a) Does inlet temperature influence the component match ? Explain. **6**

b) Define match point and explain the effect of the exit nozzle area on the match point. **7**

OR

12. a) What is an equilibrium diagram ? **5**

b) Explain the general matching procedure for two spool turbojet engine. **8**

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