Code No: NR312003 **NR**

III B.Tech I Semester Supplementary Examinations, November 2006
TURBO MACHINERY
(Production Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Establish the continuity and momentum equations for compressible flow.
   (b) What are the various stagnation properties that are encountered in compressible flow? Explain its applications in flow measurements.
   (c) A cylinder contains 0.45 m^3 of a gas at 1 bar and 80 C. The gas is compressed to a volume of 0.13 m^3, the final pressure being 5 bar. Determine the value of index 'n' for compression. Take $\gamma = 1.4$, R=294.2 J/kg K. [6+6+4]

2. (a) What are the main types of nozzles? Explain each type by drawing neat sketches.
   (b) Depict the variation of drag coefficient with Reynolds number for two-dimensional flow around a cylinder. [8+8]

3. (a) Show the relation between theoretical pressure ratios and mass flow curve of a rotary compressor. Explain also the terms choking and surging.
   (b) A centrifugal air compressor receives air at 1 bar and delivers it at 3.5 bar. Find the final temperature of air, if the initial temperature of air is 310 K. The compressor compresses 2 kg of air per second. Take $\gamma = 1.4$. [10+6]

4. (a) Give the advantages of gas turbines over steam turbines.
   (b) Describe the use of intercooling of air in a closed cycle gas turbine plant with a line diagram.
   (c) A gas turbine plant consists of two stage compressor with perfect intercooler and a single stage turbine. If the plant works between the temperature limits of 300 K and 1000 K and 1 bar and 16 bar, find the net power of the plant per kg of air. Take $C_p = 1.005$ kJ/kg K for air. [4+8+4]

5. (a) Describe briefly the methods employed for improvement of thermal efficiency of open cycle gas turbine plant.
   (b) A gas turbine takes in air at 27 C and 1 bar. The pressure ration is 4 and the maximum temperature in the cycle is 560 C. The compressor and turbine efficiencies are 0.83 and 0.85 respectively. Determine the overall efficiency if the regenerator effectiveness is 0.75. [8+8]

6. (a) Define critical pressure ratio for the nozzle of the steam turbine. Obtain analytically its value in terms of the index of expansion.
   (b) Dry saturated steam at 5.0 kg/cm^2 with negligible velocity expands adiabatically in a covergent nozzle to 1.0 kg/cm^2 and dryness fraction of 0.94. Determine the velocity of steam leaving the nozzle. [10+6]

7. (a) Explain the working of a solid and a liquid propellant rocket by drawing neat sketches.
   (b) What are the essential differences in the requirements of a turbo-prop and turbojet turbines?
   (c) The effective jet exit velocity from a rocket is 2700 m/s. The forward flight velocity is 1350 m/s and the propellant consumption is 66 kg/s. Calculate the thrust, thrust horsepower and propulsive efficiency. [6+6+4]

8. Write short notes on:
   (a) Cascade analysis
   (b) Losses in compressor
   (c) Surging and stalling
   (d) Effect of compressibility. [4×4]

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