Student Exam No. _____

# GANPAT UNIVERSITY

## B. Tech. Semester: VII (Mechanical Engineering)

## Regular Examination Nov-Dec 2015

## Turbomachinery (2ME701)

**Time:** 3 Hours **Total Marks: 70**

**Instruction:** (1) Use of Scientific calculator is permitted.
(2) Assume suitable data if necessary.
(3) Use of Steam Table and Molliar Diagram is permitted.

### Section - I

**Que. – 1**

(a) Define Turbo machines and Classify it. (6)

(b) Steam at the rate 7.5 kg/sec. Flow through set of nozzles. The inlet pressure is 14 bar and super heat is 55.87 degree Celcius. The exit pressure is 6 bar. Neglecting the velocity of approach and assume the expansion of steam is isentropic. Find the number of nozzles used, if the outlet area of each nozzle is 2.3 Square Centimeter. What should be the correct exit area. (6)

**OR**

**Que. – 1**

(a) Derive the general Euler's expression for a Turbo machine. (6)

(b) Dry saturated steam enters a steam nozzle at pressure of 15 bar and is discharged at pressure of 2 bar. If dryness – fraction of steam discharged is 0.96. What will be the final velocity of steam. Neglecting initial velocity of steam. If 10 % of heat drop is lost in fraction. Find the percentage reduction in the final velocity. (6)

**Que. – 2**

(a) In a Devel Turbine , the steam issues is with a velocity of 850 m/sec. The nozzle angle is 20 degree. Mean blade velocity is 350 m/sec. The blades are symmetrical. The mass flow rate is 1000 kg/min. fraction factor is 0.8. Determine: (6)

(1) Blade Angle (2) Axial thrust on the end bearings. (3) Power developed in kW (4) Blade Efficiency (5) Stage Efficiency, in Nozzle Efficiency is 93%

(b) What is the difference between impulse turbine and reaction turbine? (5)

**OR**

**Que. – 2**

(a) Why compounding of impulse turbine is necessary? What are various methods of reducing rotor speed? Explain anyone method with neat diagram (6)

(b) Steam flows from the nozzles of a single row impulse turbine with a velocity 450 m/s at a direction which is inclined at an angle of $16^0$ to the peripheral velocity. Steam comes out of the moving blades with an absolute velocity of 100 m/s in the direction at $110^0$ with the direction of blade motion. The blades are equiangular and steam flow rate is 6 kg/s. Determine the power loss due to friction. (5)

**Que. – 3** Explain any **three** of the following short notes. (12)

(a) Distinguish between a turbo machine and a positive displacement machine.
(b) Write note on Mach Number.
(c) Explain briefly Mixed Pressure Turbine.
(d) What is the function of Heat accumulator?

## Section – II

**Que. – 4**

(a) Define and explain following terms with reference to a Turbo jet engine. (6)
(i) Thrust (ii) Trust Power (iii) Propulsive Power (iv) Propulsive efficiency.

(b) Draw and explain Enthalpy – Entropy diagram of an Axial flow compressor. (6)

**OR**

**Que. – 4** (a) In a jet propulsion units the total pressure and total temperature at inlet of compressor are 0.6 bar and 0 $^0$C. The total pressure and total temperature of gases entering the turbine are 3.1 bar and 750 $^0$C. The isentropic efficiency of turbine and compressor are 80 % and 85 % respectively. Find work consume by compressor and Air-Fuel ratio. If calorific value of fuel is 41,840 kJ/kg, $C_{pa}$ = 1.005 kJ/kg K, $C_{pg}$ = 1.1296 kJ/kg K, $\gamma_a$ = 1.4 and $\gamma_g$ = 1.33. (6)

(b) Compare a Centrifugal compressor with Axial flow compressor. (6)

**Que. – 5**

(a) A Centrifugal compressor under test gave the following observations: - Speed 11500 rev/min, inlet total temperature 21$^0$C, Outlet and inlet total heads 4 bar and 1 bar respectively, Impellor diameter 75 cm, Sleep factor 0.92, Find Compressor efficiency. (5)

(b) What are the advantages and disadvantages of jet propulsion over the other systems? Discuss the working principle of turbojet after burner, pulse jet, ram jet etc. (6)

**Que. – 5**

In an open cycle gas turbine plant, the air enters the compressor at 15 degree Celsius and is compressed through a pressure ratio of 14. The air is then heated to 1300 degree Celsius in combustion chamber and regenerator of effectiveness 80 %. Air at 1300 degree Celsius is expanded in two stages such that the work of expansion is maximum. The air is reheated to 1300 degree Celsius before entering low pressure turbine. Determine(1) Cycle thermal efficiency (2)The work ratio and (3) Net shaft work per kg air. The isentropic efficiency may be assumed as 0.85 and 0.86 for compressor and turbine respectively. Calculate flow rate of air for an output of 240 MW. Assume $\eta_{mech}$ = 0.99 for compressor, turbine and generator individually (11)

**Que. – 6** Explain any **three** of the following short notes. (12)

(a) Explain working of an turbo jet engine with the help of diagram.

(b) State and explain the assumption made for ideal energy transfer for Centrifugal compressor.

(c) What do you mean by propulsive power and propulsive efficiency?

(d) Explain the operating principle of a waste heat recovery boiler with examples.

END OF PAPER