*Seat No.: _____* *Enrolment No._____*

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE SEM-VIII Examination May 2012**

**Subject code: 181904**

**Subject Name: Thermal Engineering**

**Date: 16/05/2012** **Time: 10.30 am – 01.00 pm**

**Total Marks: 70**

## Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of steam table and Mollier chart is allowed.**

**Q.1** **(a)** What is critical pressure? Derive the expression for critical pressure ratio in flow through nozzles. Calculate its value for superheated steam. **07**

**(b)** What do you mean by compounding of steam turbine? Explain with neat diagram velocity compounded impulse turbine. **07**

**Q.2** **(a)** Describe with neat sketch closed cycle gas turbine. Write its merits and demerits over open cycle gas turbine. **07**

**(b)** Steam is expanded in a set of nozzles from 10 bar and 200 ºC to 5 bar. Is the nozzle convergent or convergent-divergent? Assuming the isentropic expansion of steam, calculate the minimum area of nozzles to flow steam at the rate of 3 kg per second. Neglect the initial velocity and take coefficient of discharge Cd = 0.97. **07**

**OR**

**(b)** Explain combined steam and gas turbine power plant with neat schematic diagram. Also discuss its importance. **07**

**Q.3** **(a)** What do you mean by governing of steam turbine? State various methods of governing and explain with neat sketch the Nozzle Control Governing. **07**

**(b)** A mean blade ring diameter of a single stage impulse turbine is 1.3 meter. It runs at 3200 R.P.M.The nozzle angle is 15º and blade speed ratio is 0.45.The blade friction factor is 0.9 and the discharge is axial. Calculate blade inlet and outlet angles and Power output per kg of steam. **07**

**OR**

**Q.3** **(a)** Define the term "Degree of Reaction". Explain Parson's reaction turbine. **07**

**(b)** The following data refer to a stage(One ring of fixed blades and one ring of moving blades) of Parson's reaction turbine: **07**

The mean diameter of blade ring is 680 mm. Running speed is 3100 R.P.M. The steam velocity at exit from fixed blades is 160 m/s.

Blade outlet angle is 21º.

Steam flow rate through blades is 7.4 kg per second.

Draw the velocity diagram and find :

(i) Blade inlet angle

(ii) Power developed in the stage.

(iii) The maximum blade efficiency.

**Q.4** **(a)** Derive the expression of optimum pressure ratio for maximum work **07**

out put in actual Brayton Cycle.

**(b)** The compressor of an open cycle constant pressure gas turbine draws air at pressure 1 bar and temperature 300 K.The pressure of air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 77 % and 85 % respectively. The A:F ratio is 78:1.Calculate the power developed and thermal efficiency of the cycle for the mass flow rate of air = 2.7 kg per second. **07**

Take Cp = 1 kJ/kg K and $\gamma = 1.4$ for air and gases both.

The calorific value of fuel used is 42 MJ per kg.

**OR**

**Q.4** **(a)** Explain in brief with neat diagrams the various methods used to improve the efficiency and specific out put of a simple open cycle gas turbine plant. **07**

**(b)** A gas turbine plant draws air at 1 bar and 295 K. Air is compressed to 4 bar and then heated to a temperature of 850 K.The efficiencies of compressor and turbine are 81 % and 87 % respectively. Neglect the pressure drop. **07**

Determine the overall efficiency of the plant :

(1) Without regenerator and

(2) With the regenerator of 71 % effectiveness.

Take Cp = 1 kJ/kg K and $\gamma = 1.4$ for air and gases both.

**Q.5** **(a)** Write a short note on: "Turbo prop engine." **07**

**(b)** Explain with neat sketch "Ram jet engine." **07**

**OR**

**Q.5** **(a)** Discuss the losses in steam turbines. **07**

**(b)** Write a short note on "Pass-out turbine." **07**

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