

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2171917

Date: 11/05/2017

Subject Name: Steam and Gas Turbines

Time: 02.30 PM to 05.00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** What is the principle of jet propulsion? State advantages & disadvantages of jet propulsion **07**
- (b)** Write short note on Ram jet engine. **07**
- Q.2 (a)** Describe different types of nozzle with neat sketch. **07**
- (b)** Steam is expanded in a nozzle from 15 bar & 350°C to 5 bar. Find the throat & exit area if the flow rate is 1 kg/sec. What should be the coefficient of velocity if the exit velocity is 650 m/sec? **07**
- OR**
- (b)** Derive an expression for velocity of steam at exit of nozzle. **07**
- Q.3 (a)** What do you understand by compounding of steam turbine? Explain any one with neat sketch. **07**
- (b)** Steam issues from the nozzles of a De Laval turbine with a velocity of 1400m/sec. The nozzle angle is 15°, the mean blade velocity is 450 m/sec & the inlet and outlet angle of blade are equal. The mass of steam flowing through turbine per hour is 1000 kg. Determine: (1) The blade angles (2) The relative velocity of steam entering the blades (3) The tangential force on the blades (4) The power developed (5) The blade efficiency. Assume that $K=0.8$ **07**
- OR**
- Q.3 (a)** Derive an expression for maximum blade efficiency for a single stage impulse steam turbine. **07**
- (b)** Give detailed classification of steam turbines. **07**
- Q.4 (a)** The following particulars refer to a stage of a Parson's steam turbine comprising one ring of fixed blades & one ring of moving blades, mean diameter of blade ring is 80 cm, turbine speed is 3000 rpm, steam velocity at exit from blades is 180 m/sec, blade outlet angle is 16°, steam flow through blades is 10 kg/sec. Draw the velocity diagram & find the following. **07**
- (1) Blade inlet angle (2) Tangential force on the ring of moving blades
(3) Power developed in a stage.
- (b)** Make a list of improving the efficiency & specific output of simple gas turbine plant. **07**
- OR**
- Q.4 (a)** Derive an expression for net work done by gas turbine power plant. Also state the condition of maximum work done. **07**

- (b) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar & temperature 20°C. The pressure of the air after compression is 4 bar. The isentropic efficiency of compressor and turbine are 80% & 85 % respectively. The air fuel ratio used as 90:1, of the flow rate of air is 3 kg/sec. find: (1) Power developed (2) Thermal efficiency of the cycle
Assume $C_p = 1 \text{ kJ/kg K}$ & $\gamma = 1.4$ for air & gas and calorific value of fuel is 42000 kJ/kg. 07
- Q.5** (a) In a combined cycle power plant. Compressor takes 1500 tones air /hour at 26°C and 1 bar pressure. The maximum temperature of gas turbine is limited to 850°C. The pressure ratio is 8. The exhaust gases coming from gas turbine is heated further to 700°C before entering into heat recovery steam generator. The steam is generated at 50 bar & 500°C. The exhaust gas temperature is limited to 200°C to avoid the condensation of corrosive gases. The condenser pressure is 0.07 bar. Assume isentropic compression in compressor and isentropic expansion in both turbines. Calculate (1) power generated in each unit of the cycle (2) Specific fuel consumption (3) Thermal efficiency of each cycle & combined cycle.
Take $C_p = 1 \text{ kJ/kg K}$ & $\gamma = 1.4$ for air & gas and calorific value of fuel=41000 kJ/kg. 07
- (b) Explain throttle governing of steam turbine with neat sketch. 07
- OR**
- Q.5** (a) State the different arrangement of combined cycle power plants and explain any one with neat sketch. 07
- (b) Explain physical significance of critical ratio. 07
