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. (1) Blade inlet angle (2) Tangential force on the ring of moving blades (3) Power developed in a stage.	**07**
	(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 **07**

Assume C_p =1 kJ/kg K & γ= 1.4 for air & gas and calorific value of fuel is 42000 kJ/kg.

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. **07**

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 kJ/kg K & γ=1.4 for air & gas and calorific value of fuel=41000 kJ/kg.

(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**

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