Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2171917 **Date: 05/12/2019**

Subject Name: Steam and Gas Turbines

Time: 10:30 AM TO 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.**

Q.1	**(a)**	Define: (1) Blade efficiency (2) Stage efficiency (3) Degree of reaction.	**03**
	(b)	Explain various applications of gas turbine.	**04**
	(c)	Explain with neat sketch combined steam and gas turbine power plant.	**07**
Q.2	**(a)**	Explain different types of nozzle with neat sketch.	**03**
	(b)	Discuss advantages and disadvantages of gas turbine over steam turbine.	**04**
	(c)	Derive condition for maximum discharge through the nozzle.	**07**
		OR	
	(c)	Derive an expression for velocity of steam at exit of nozzle.	**07**
Q.3	**(a)**	What do you mean by compounding of steam turbine? Why it is necessary?	**03**
	(b)	Write comparison between impulse turbine and reaction turbine.	**04**
	(c)	A steam nozzle is to be designed for a mass flow rate of 8 kg/s of steam from 8 bar and 350^0 C to a back pressure of 1 bar. The nozzle efficiency is 0.93 and the frictional loss is assumed to take place in the diverging portion of the nozzle only. Assume a critical pressure ratio of 0.5457. Determine the throat and exit area.	**07**
		OR	
Q.3	**(a)**	Define: (1) Reheat factor (2) Internal efficiency (3) Isentropic efficiency.	**03**
	(b)	Give detailed classification of steam turbines.	**04**
	(c)	A nozzle expands steam from 12 bar and 250^0 C to 6 bar. Is the nozzle convergent or convergent divergent? Neglecting the initial velocity, find the minimum area of the nozzle to flow 2 kg/s of steam under the given conditions. Assume the expansion of steam is isentropic. Calculate the actual throat area if the coefficient of discharge is 0.98.	**07**
Q.4	**(a)**	Write comparison between throttle governing and nozzle governing.	**03**
	(b)	Draw a neat sketch of pressure – velocity compounded impulse turbine.	**04**
	(c)	Derive an equation of thermal efficiency of ideal Brayton cycle. Also draw P-V & T-S diagram.	**07**
		OR	
Q.4	**(a)**	Define: (1) Thrust (2) Thrust power (3) Propulsive efficiency.	**03**
	(b)	Explain principle of jet propulsion with neat sketch.	**04**
	(c)	Explain construction & working of Turbo-prop engine.	**07**
Q.5	**(a)**	List out different types of losses in steam turbine.	**03**
	(b)	Write a short note on pulse jet engine.	**04**
	(c)	In a constant pressure open cycle gas turbine air enters the compressor at 1 bar and 18^0 C where it is compressed to a pressure ratio of 6. The gases enters the gas turbine at 730^0 C and expands to original pressure. Calculate the work ratio and the thermal efficiency when gas turbine plant operates on a brayton cycle.	**07**

Assume, $\gamma = 1.4$, $C_p = 1$ KJ/kg K for air and $\gamma = 1.3$, $C_p = 1.1$ KJ/kg K for gases. Neglect the mass of fuel.

OR

Q.5 **(a)** Write comparison between open cycle and closed cycle gas turbine. **03**

(b) Draw P-V & T-S diagram for gas turbine cycle with: (1) Intercooler (2) Reheating (3) Regeneration **04**

(c) A gas turbine installations works on brayton cycle between the temperature limits of 35^0 C and 715^0 C. For the maximum work to be developed, calculate temperature at the end of compression, pressure ratio and thermal efficiency. Also calculate work ratio and power output if mass flow rate of air is 20 kg/s. **07**

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