Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER – I EXAMINATION – SUMMER 2017

Subject Code: 2713902 **Date:10/05/2017**

Subject Name: Energy Conversion Systems

Time:02:30 p.m. to 05:00 p.m. **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 is permitted.**

Q.1	**(a)**	Explain the primary and secondary energy sources along with their thermodynamics of energy conversion.	**07**
	(b)	Write a short note on twin bed gassifier.	**07**
Q.2	**(a)**	Explain with neat sketch construction and working of HTGR.	**07**
	(b)	Determine the fuel gas analysis and air fuel ratio by weight when fuel oil with 84.9% carbon, 11.4% hydrogen, 3.2% sulphur, 0.4% oxygen and 0.1% ash by weight is burnt with 20% excess air, assume complete combustion.	**07**
		OR	
	(b)	Explain energy conversion through Fission and Fusion process.	**07**
Q.3	**(a)**	Explain water treatment and blow down in case of boilers.	**07**
	(b)	Steam flows into nozzles of an Impulse-Reaction turbine stage from the blades of the preceding stage with a velocity of 100m/s and issues from the nozzles with a velocity of 325m/s at an angle of 20^0 to the wheel plane. Calculate the gross stage efficiency for the data given as: mean blade velocity- 180m/s, Expansion efficiency for nozzle and blade – 0.9, carryover factor for nozzle and blades – 0.9, Degree of reaction – 0.26, blade outlet angle – 28^0.	**07**
		OR	
Q.3	**(a)**	Explain circulating Fluidized Bed Combustion System in boiler.	**07**
	(b)	A Gas turbine draws air at 1 bar and 295K. Air is compressed to 4 bars and then heated to temp. of 850K. The efficiency of compressor and turbine are 81% and 87% resp. Neglecting pressure drop, calculate overall efficiency of plant (i) without regenerator (ii) with regenerator. Take Cp = 1 kJ/KgK and γ =1.4 for gas and air.	**07**
Q.4	**(a)**	Explain actual Brayton gas turbine cycle with T-S diagram. Using equation of work done, derive the equation of optimum pressure ratio for max. work output in actual cycle.	**07**
	(b)	The first stage wheel running at 1500rpm of a 20000kW turbine is a single raw wheel having a mean diameter 2.1m. The condition of steam in the first stage is as follows: pressure – 17.5 bar, superheat – 110^0C, specific volume – 0.1503m^3/kg. The blades are 3.2cm long and active nozzles cover 40% of the total circumference at full load: Calculate :(i) power absorbed by disc friction (ii) power absorbed by blade windage and disc friction. Take co-efficient of viscosity = 95.29 x 10^{-7} kg/ms	**07**
		OR	
Q.4	**(a)**	Discuss the need of governing in steam turbines. Explain any one method of governing.	**07**

	(b)	An open cycle gas turbine takes air at 1 bar and 25^0C. The pressure ratio is 6.5 and max. temp. is 580^0C.Assume compression and expansion are isentropic, calculate (i) net work produced by plant per kg of fuel (ii) mass flow rate of fuel and max. work saved when perfect inter-cooling is used when power developed by plant is 10,500KW. Take Cp = 1.05 kJ/KgK and γ =1.4 for gas and air. $C.V._{fuel}$ = 42000 kJ/Kg.	**07**
Q.5	**(a)**	Discuss the needs and benefits about waste heat recovery.	**07**
	(b)	Discuss about the saving potentials of the co-generation & Tri-generation system.	**07**

OR

Q.5	**(a)**	Explain the waste heat recovery techniques in economizer and plate type heat exchanger with neat sketch.	**07**
	(b)	Write a short note on: (1) Gas turbine co-generation system (2) Features and benefits of Tri-generation system	**07**

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