Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015

Subject code: 181904 **Date: 07/05/2015**

Subject Name: Thermal Engineering

Time: 10.30AM-01.00PM **Total Marks: 70**

Instructions: Attempt all questions.

1. **Make suitable assumptions wherever necessary.**
2. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive expression for Mass flow rate of steam through the nozzle.	**07**
	(b)	Why are turbines compounded? Explain different method of compounding.	**07**
Q.2	**(a)**	A steam nozzle is to be designed for a mass flow rate of 8kg/s of steam from 8 bars and 350^0C to a back pressure of 1 bar. The nozzle efficiency is 0.93 and the frictional losses are assumed to take place in the diverging portion of the nozzle only. Assume a critical ratio of 0.5457. Determine throat and exit area.	**07**
	(b)	Explain supersaturated flow of steam in nozzle and sketch the process on h- s diagram. Also state effect of supper saturation	**07**
		OR	
	(b)	Explain the effect of varying the back pressure in convergent divergent nozzle and state when maximum flow occurs in the nozzle.	**07**
Q.3	**(a)**	Derive condition for maximum blade efficiency of impulse turbine	**07**
	(b)	A simple impulse turbine has mean blade ring diameter of 100 cm and runs at 5000 rpm. The nozzle angle is 16^0 and steam leaves at nozzle with velocity of 800 m/s. The blade is equiangular and blade friction factor is 0.9. Determine: (i) the inlet angle of blade for shock-less entry of steam, (ii) the diagram power for steam flow of 800 kg/h (iii) the diagram efficiency, (iv) the axial thrust and (v) the loss of K.E. due to friction.	**07**
		OR	
Q.3	**(a)**	Explain Reheat-Regenerative feed heating cycle with neat sketch and draw the cycle on h-s and T-s diagram derive thermal efficiency.	**07**
	(b)	A steam is supplied to three stage turbine at 30 bar and 400^0C. Steam is exhausted at 0.05 bar. The inter-stage pressure are 6 bar and 1 bar. Stage efficiency for all stage is 76%. Assuming condition line to be straight, determine : (i) Rankine efficiency, (ii) Quality of the steam leaving each stage, (iii) reheat factor,(iv) work done per kg of steam in each stage , and(v) overall efficiency.	**07**
Q.4	**(a)**	Derive the expression work done and efficiency for Ideal Brayton cycle of Gas turbine.	**07**
	(b)	A gas turbine unit has pressure ratio of 6 and maximum cycle temperature is 900^0C. The isentropic efficiencies of the compressor and turbine are 85% and 90% respectively. Air enters the compressor at 15^0C at the rate of 5 kg/s. Calorific value of fuel used is 43000 kJ/kg, combustion efficiency is 95%. Using Cp_{air} = 1kJ/kgK^0 Cp_{gas} =1.07 kJ/kgK^0 , and γ = 1.4 for air and gases, find (i) thermal efficiency,(ii) power output (iii) air fuel ratio and (iv) specific fuel consumption.	**07**

OR

Q.4	**(a)**	Derive expression for ideal Open cycle gas turbine with inter-cooling reheating and regeneration	**07**
Q.4	**(b)**	Steam issued from the nozzle of a De Laval turbine with velocity of 1400 m/s. The nozzle angle is 15^0 . the mean blade velocity is 450 m/s and inlet and outlet angle of blade are equal. The mass of steam flowing through turbine per hour is 1000 kg. Determine (i) The blade angles, (ii) the relative velocity of steam entering the blades, (iii) the tangential force on the blade ,(iv) the power developed and (v) the blade efficiency. Assume that friction factor K=0.8.	**07**
Q.5	**(a)**	Explain with neat sketch Working of steam and Gas combined cycle power plant. Give advantages of combined cycle power plant	**07**
	(b)	Explain the principle of Jet propulsion and give classification of Propulsive engine.	**07**

OR

Q.5	**(a)**	Explain with neat sketch various method of attachment of blades to turbine rotor	**07**
	(b)	Write short note on following(any Two) (i) Back pressure turbine (ii) Labyrinth packing. (iii) Ramjet engine	**07**

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