Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEMESTER VIII– EXAMINATION – SUMMER 2017

Subject Code:X81901 Date: 27/04/2017

Subject Name: Thermal Engineering

Time: 10.30AM to 01.00PM 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)**	Derive mass flow rate and condition for maximum mass flow rate through a steam nozzle.	**07**
	(b)	Derive general relationship between area, velocity and pressure for nozzle flow also discuss the effect of mach number on convergent and divergent area.	**07**
Q.2	**(a)**	Explain Pressure velocity compounded impulse turbine with neat sketch.	**07**
	(b)	The throat diameter of round sectional nozzle is 0.6 cm. steam with initial pressure of 10 bar and 80°C of superheat is to be expanded down to a back pressure of 1.05 bar, what is its mass flow rate and exit velocity? What is the angle of cone used for divergent portion of nozzle, if the length of divergent portion is 5cm.	**07**
		OR	
	(b)	In a stage of an impulse turbine provided with row wheel, the mean diameter of the blade ring is 90 cm and the speed of rotation is 3000rpm. The steam issues from the nozzle with a velocity of 350 m/s and the nozzle angle is 22°. The rotor blades are equiangular and due to friction in the blade channels relative velocity of the steam at outlet from the blades is 0.85 times the relative velocity of steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 150 N?	**07**
Q.3	**(a)**	Explain Reheat factor and internal efficiency for steam turbine. Derive the relation between stage efficiency, internal efficiency and reheat factor.	**07**
	(b)	Why governing of steam turbine is required? Explain throttle governing of steam turbine.	**07**
		OR	
Q.3	**(a)**	Explain Pearson's reaction turbine. Derive an expression for maximum efficiency of Pearson's reaction turbine	**07**
	(b)	In a stage of 50% reaction turbine, the steam consumption is 6 kg/s and runs at 500 rpm. The discharge blade tip angles are 22º both for fixed and moving blades. The axial velocity of flow is 0.75 times the blade velocity. Determine the drum diameter and blade height of a particular turbine pair where pressure of steam of steam is 1.7 bar of dryness fraction 0.96. The power developed by th turbine amounts to 4 kW.	**07**
Q.4	**(a)**	Explain the open cycle gas turbine plant with neat sketch. Also show it on T-s Diagram and derive an expression for the thermal efficiency.	**07**

(b) In a closed cycle gas turbine the following data was observed, **07**

Working substance is air, C_p = 1 kJ/kg and γ =1.4
Ambient temperature = 27º C
Top temperature = 823º C
Pressure at compressor inlet = 1 bar
Pressure ratio = 4
Compressor efficiency = 80%
Turbine efficiency = 85%
Heating value of fuel = 41800 kJ/kg
Heater loss = 10% of heating value

Find the following :
1) Compressor work 2) Heat supplied 3) Turbine work 4) Net work
5) Thermal efficiency 6) Work ratio

OR

Q.4 **(a)** How can thermal efficiency of simple gas turbine be improved? Explain with neat sketch the one of the method. **07**

(b) Explain combined steam and gas cycle power plant with neat sketch. State advantages of combined cycle advantages. **07**

Q.5 **(a)** Explain the principle of jet propulsion. Classify the propulsion engines. **07**

(b) Explain the turboprop engine with neat sketch. State advantages and disadvantages of turboprop engine. **07**

OR

Q.5 **(a)** Explain Pass out steam turbine with neat sketch. Represent the process of pass out turbine on T-s and h-s diagram. **07**

(b) Write a short not on Losses in steam turbine. **07**

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