Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: ME207

Course Name: THERMAL ENGINEERING-I

Max. marks: 100 Use of steam tables and heat transfer data book permitted. Duration: 3 hours

PART A

Answer any three full questions, each carries 10marks.

			Marks
1	a)	Explain Kelvin Plank and Classius statements.	(5)
	b)	Evaluate specific quantities of enthalpy and entropy of steam at 20bar when it is i) wet with dryness fraction 0.85 ii) with degree of superheat 50ºC.	(5)
2	a)	Derive an expression for thermal efficiency of Rankine cycle.	(5)
	b)	In a steam power station, steam flows steadily through a 0.2m diameter pipeline from the boiler to the turbine. The specific values of enthalpy and volume of steam at boiler and turbine end conditions are 3213.6kJ/kg, 0.073m^3/kg & 3202.6kJ/kg, 0.084m^3/kg. There is a heat loss of 8.5kJ/kg from pipeline. Calculate steam flow rate.	(5)
3	a)	What are the limitations of First Law of Thermodynamics?	(4)
	b)	Make a schematic diagram of binary vapour cycle and obtain thermal efficiency of the cycle.	(6)
4	a)	Combining first and second laws of Thermodynamics, obtain Tds equations.	(6)
	b)	List the different types of surface condensers and explain any one of them.	(4)

PART B

Answer any three full questions, each carries 10marks.

5	a)	Explain working of Babcock & Wilcox boiler.	(6)
	b)	Find the percentage saving in work done by a reciprocating compressor in two stages from 1bar to 7bar instead of one stage. Assume compression index as 1.35. The two stage compression process takes place with complete intercooling.	(4)
6	a)	With a neat sketch, explain the working of a reciprocating compressor.	(5)
	b)	In a thermal plant, steam is supplied at 30bar, 300ºC and is expanded to 5bar in the turbine. It is reheated to the same temperature and expanded further to 0.05 bar. Find thermal efficiency of the cycle.	(5)
7	a)	Differentiate between reciprocating and rotary compressor.	(4)
	b)	Dry saturated steam at a pressure of 8bar enters a convergent divergent nozzle and leaves it at 1.5bar. If the flow is isentropic, find the ratio of cross-sectional area at exit and throat for maximum discharge.	(6)
8	a)	What is meant by reheat factor in multistage turbines?	(4)
	b)	A single acting reciprocating air compressor has cylinder diameter 200mm and length of stroke 300mm respectively. Air enters the compressor at 1bar, 27ºC and delivers at 8bar. Estimate the work done and power developed if the compressor runs at 100rpm. Take n = 1.25.	(6)

PART C

Answer any four full questions, each carries 10marks.

9	a)	Describe the working of a closed cycle gas turbine power plant.	(4)
	b)	A furnace wall is made up of refractory bricks of 300mm thick. The inner and outer surfaces of the wall have temperatures 1000ºC and 150ºC. Find the heat loss per square metre per hour. The outside wall temperature becomes 50ºC when it is covered with insulating bricks of 200mm thickness. The thermal conductivities of refractory and insulating bricks are 4.5W/mK and 0.5W/mK respectively. Find the reduction in heat loss.	(6)
10	a)	State and explain Fourier's heat conduction equation.	(4)
	b)	In a gas turbine plant, air enters at 1bar, 18ºC and gets compressed to 4bar in a compressor with efficiency 80%. Temperature of air rises to 645ºC in the combustion chamber. If the thermal efficiency of the plant is 19%, find the isentropic efficiency of turbine. Mass of fuel is neglected.	(6)
11	a)	State Kirchoff's Law. What is its significance?	(4)
	b)	A gas turbine plant consists of two stage compressor with perfect intercooler and a single stage turbine. If the plant works between 1bar, 300K and 16bar, 1000K, find the net power of the plant per kg of air.	(6)
12	a)	Find thermal efficiency of Brayton cycle in which a gas turbine plant works.	(5)
	b)	How will you calculate heat transfer rate in free and forced convection? What are the non dimensional numbers involved and explain their importance?	(5)
13	a)	List few advantages and disadvantages of gas turbine plants.	(5)
	b)	Water flows inside a tube of length 3m and diameter 5cm at a velocity 0.8m/s. The mean water temperature is 50ºC and wall temperature 70ºC. Determine heat transfer coefficient and heat transfer rate.	(5)
14	a)	Define the terms absorptivity, reflectivity and transmittivity.	(3)
	b)	Determine the efficiency of gas turbine plant with heat exchanger of effectiveness 75%. Gas enters at 290K and the maximum temperature in the cycle is 925K. Assume the turbine efficiency as 88% and compressor efficiency 85%. Find the efficiency of the plant without heat exchanger.	(7)

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