Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: ME405

Course Name: REFRIGERATION AND AIR CONDITIONING

Max. Marks: 100 Duration: 3 Hours

Use of Refrigeration tables, Charts and Psychrometric chart is permitted.

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) Define COP and Tonnes of refrigeration. (4)

b) In a Bell-Coleman refrigerator air is drawn into the cylinder of the compressor from cold chamber at a pressure of 1.03 bar and temperature 12^{o}C. After isentropic compression to 5.5bar the air is cooled at constant pressure to a temperature of 22^{o}C.The polytropic expansion $pV^{1.25}$= constant follows and air expanded to 1.03 bar is passed to cold chamber. Determine (1) Work done/kg of air flow (2) Refrigerating effect/kg of air flow (3) COP (6)

2 a) With the help of neat sketches explain working of vortex tube refrigeration system (4)

b) A freezer of 20 TR capacity has evaporator and condenser temperature of -30^{o}C and 25^{o}C respectively. The refrigerant R-12 is sub-cooled by 4 ^{o}C before entering the expansion valve and is superheated by 5^{o}C before entering the evaporator. If a six cylinder single acting compressor with stroke equal to bore running at 1000 rpm. is used. Determine 1. COP 2. Theoretical piston displacement per minute 3. Theoretical bore and stroke (6)

3 a) With the help of neat sketches explain the working of a simple vapour compression refrigeration system. (4)

b) A food storage locker with R12 refrigerant requires a refrigeration of 2400kJ/min. capacity has an evaporator temperature of 263K and a condenser temperature of 303K.The refrigerant is sub cooled by 6^{o}C before entering the expansion valve and vapour is superheated by 7^{o}C before leaving the evaporator coil. The refrigeration compressor is a two cylinder single acting with stroke equal to 1.25 times the bore and operates at 1000rpm. Calculate 1. Mass of refrigerant circulated/min. 2. Heat removed by condenser/min 3.Theoretcal bore and stroke. (6)

4 a) Derive an expression for COP of an Reversed Brayton cycle air refrigeration system (4)

b) A regenerative air cooling system is used for an airplane to take 20 TR. The ambient air at a pressure of 0.8 bar and temperature 10°C is rammed isentropically till pressure rises to 1.2 bar. The air bled off the main compressor at 4.5 bar is cooled by the ram air in the heat exchanger whose effectiveness is 60%. The air from the heat exchanger is further cooled to 60°C in the regenerative heat exchanger. The cabin is to be maintained at a temperature of 25°C and pressure of 1 bar. If the isentropic efficiencies of compressor and turbine are 90% and 80% respectively, Find (1) Mass of air bled from cooling turbine to be used for regenerative cooling (2) Power required and (3) COP. (6)

PART B

Answer any three full questions, each carries 10 marks.

5 A two stage vapour compression machine with a flash inter cooler is to produce 30 TR while working between -35°C and 45°C. The pressure in the flash cooler is the geometric mean of the upper and lower limits. The suction gas to the low pressure compressor is super heated by 5°C and the condenser liquid is sub cooled by 5°C. The working substance is R-12. Determine (i) COP (ii) power (iii) Fluid flow through LP and HP compressor (10)

6 Explain working of a refrigeration system with multiple evaporators of different capacity with figure. (10)

7 a) Explain with a neat diagram working of a domestic refrigerator (6)

b) Compare deep freezing and cold storage (4)

8 Explain any one type of commonly used cooling tower with a diagram (10)

PART C

Answer any four full questions, each carries 10 marks.

9 a) Air at 25°C, 70% RH and 1 bar is compressed to 2 bar and cooled back to 25°C. Find water condensation per kg of air (6)

b) Define the terms: (a) DPT, (b) RH (c) WBT (d) SHF and show them on a psychrometric chart (4)

10 a) With the help of a neat diagram, explain the working of a winter air conditioning system (6)

b) Derive Bernoulli's equation from energy equation through second law considerations. (4)

11	a)	Explain in detail about "Equal Friction Method "in duct design	(5)
	b)	Differentiate between Packaged and Central air conditioning systems	(5)
12	a)	Moist air exists at 24^{o}C DBT and 18^{o}C WBT. Find the properties of air at 101.325 kPa using equations. Also find the properties at 80 kPa.	(6)
	b)	Ambient air at 40^{o}C DBT and 30% RH is cooled in an air washer of 85% efficiency. Find the properties of humid air?	(4)
13		2.5 kg of air is cooled and dehumidified from 30^{o}C DBT, 40% RH to 15^{o}C DBT & 80% RH in a cooling and dehumidifying coil. Find (i) ADP, (ii) Bypass Factor and (iii) Heat Transfer. If bypass factor is halved keeping the ADP same find (iv) exit air condition and (v) Heat Transfer.	(10)
14		With the help of a neat diagram explain year round refrigeration system	(10)

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