Exam Date & Time: 08-Jan-2024 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING END SEMESTER MAKE UP EXAMINATION- JANUARY 2024

Refrigeration and Air Conditioning [MME 4051]

Marks: 50 **Duration: 180 mins.** Descriptive Answer all the questions. Section Duration: 180 mins Discuss the brief history of the refrigeration system. 1A) (2)With a neat diagram, explain the working principle of a bell Coleman cycle. Also, derive 1B) an expression for the COP of the system (3) A regenerative air cooling system is used for an airplane to take 20TR. The ambient air 1C) is at 0.8 bar and 10^{0} C. It is rammed isentropically till the pressure rises to 1.2 bar. The air bled from 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 with the portion of air bled after expansion in (5) the cooling turbine. The temperature of air leaving the regenerative heat exchanger is 100^{0} C. The cabin is to be maintained at 25^{0} C and 1 bar. If the isentropic efficiency of the compressor and turbine are 90% & 80% respectively, find; (i) Mass of air bled from cooling turbine to be used for regenerative cooling (ii) Power required. (iii) COP 2A) Discuss the influence of evaporator pressure and condenser pressure on the performance of vapor compression refrigeration system (2)2B) With a neat diagram explain the working principle of a multistage vapor compression refrigeration system with flash intercooler. Also an derive an expression for the COP (3)With an appropriate sketch explain ammonia-based vapor absorption system and derive 2C) an expression for the maximum COP (5)3A) Clearly explain the advantages and disadvantages of vapor compression over vapor absorption refrigeration system (2)With a neat sketch explain the working of a steam jet refrigeration system 3B) (3) A compound refrigeration system using R-12 as the refrigerant consists of evaporators 3C) (5)of capacities 30 TR at -10°C, 20 TR at 5°C and 10 TR at 10°C. Vapor leaving the evaporators are dry and saturated. The system is provided with multiple compressors, multiple expansion valves and flash intercoolers. Condenser temperature is 40°C. Assuming isentropic compression at each stage find

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	a. Mass of the refrigerant through each compressor	
	b. Total power required	
	c. COP	
4A)	Discuss the various refrigerants and their action on the environment concerned with ozone depletion potential and global warming	(2)
4B)	Define specific humidity, relative humidity dew point temperature and bypass factor	(3)
4C)	A 15-ton refrigeration system is used to make ice. Refrigerant R-12 is used with saturated temperature limits of -25 °C and 55°C. Refrigerant is sub-cooled by 10°C before admitting into the evaporator. Vapor is dry saturated at the entry into the compressor. Determine (a) COP (b) power input required in kW. Also determine the dimensions of a compressor running with a rpm of 200 and volumetric efficiency of 88% and L/D ratio of 1.2	(5)
5A)	Derive the relation between specific humidity, partial pressure of water vapor and total pressure.	(2)
5B)	With a schematic representation explain the working of a summer air conditioner and show the processes on a psychrometric chart	(3)
5C)	Atmospheric conditions are 715 mm of mercury and 30° C and w = 12.5 gms/kg of dry air. Determine	
	a. Partial pressure of air	
	b. Relative humidity	
	c. Dew point temperature	(5)
	d. Enthalpy	
	e. Specific volume	

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