University of Mumbai

Examination Summer 2022

Program: Mechanical Engineering

Curriculum Scheme: REV- 2019 'C' Scheme

Examination: TE

Semester: VI

Course Code: MEC603

Course Name: HVAC&R

Time: 2 hour 30 Minutes

Max. Marks: 80

N. B. :
1. All questions are **compulsory.**
2. Assume suitable data if required and state it clearly.
3. Use of Steam Table, Psychrometric chart, P-H Chart is permitted.

Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	If a heat pump cycle operates between the condenser temperature of +27°C and evaporator temperature of -23°C, then the Carnot COP will be
Option A:	0.2
Option B:	1.2
Option C:	5.1
Option D:	6
2.	For summer air conditioner which of the following psychrometric process is applicable
Option A:	Cooling & Dehumidification
Option B:	Only Cooling
Option C:	Cooling & Humidification
Option D:	Only dehumidification
3.	In case of sensible cooling of air, the coil efficiency is given by
Option A:	BPF-1
Option B:	1-BPF
Option C:	1+ BPF
Option D:	1/BPF
4.	In load estimation, RSH = 39 and RLH = 13 then what will be value of RSHF
Option A:	0.36
Option B:	0.29
Option C:	0.47
Option D:	0.75
5.	Heat is absorbed by the refrigerant, during vapour compression refrigeration cycle in
Option A:	Compressor
Option B:	Condenser

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Option C:	Evaporator
Option D:	Throttling valve
6.	The boiling point of ammonia is
Option A:	-100°C
Option B:	-50°C
Option C:	+33.3°C
Option D:	-33.3°C
7.	Atmospheric air with DBT of 28°c and WBT of 17°c is cooled to 15°c without changing its moisture content. Find original relative humidity, Final relative humidity and Final wet bulb temperature
Option A:	34% ,73% , 12°c repectively
Option B:	64% ,33% , 12°c repectively
Option C:	74% ,23% , 12°c repectively
Option D:	94% ,13% , 12°c repectively
8.	Equal friction method of designing air conditioning ducts
Option A:	Is ideal when the system is balanced
Option B:	Is ideal when the system is not balanced
Option C:	Is ideal only for return ducts
Option D:	Is ideal for none of the above
9.	When the moisture is added in to air at constant dry bulb temperature the process is known as
Option A:	Dehumidification
Option B:	Humidification
Option C:	Sensible cooling
Option D:	Sensible heating
10.	In HVACR industry refrigerant Air is designated as
Option A:	R-717
Option B:	R-744
Option C:	R-764
Option D:	R-729

Q2	**Solve any Four out of Six Questions** **5 marks each**
A	Define i) Relative humidity ii) Ton of Refrigeration iii) Degree of Saturation, iv) Dew point temperature v) Coefficient of performance
B	What is the effective temperature? Which are the factors governing effective temperature?
C	What are the properties of good refrigerant? Compare the primary and secondary refrigerant with few examples.
D	Explain the various methods of duct design
E	Explain with suitable sketch working of Simple vapor absorption refrigeration system.
F	Explain the effect of changing evaporator pressure & condenser pressure on COP of VCR cycle with P-H Diagram.

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Q3	Solve any Two Questions out of Three	10 marks each
A	The cockpit of a jet plane is to be cooled by a simple air refrigeration system. The data available is as follows. Cockpit cooling load =20 TR Speed of the plane = 1000km/hrs Ambient air temperature = -15°C Ram efficiency = 90% Pressure ratio in the main compressor =3 Pressure drop in the heat exchanger =0.1 bar Isentropic efficiencies of main compressor and turbine = 80% Temperature of air entering the cooling Turbine = 30°C Pressure of the air leaving the cooling turbine = 1.06 bar Pressure in the cockpit = 1 bar If the cockpit is to be maintained at 25°C find 1) Stagnation temperature and pressure of air entering the main compressor 2) Mass flow rate of air to cockpit 3) Power required to drive the refrigerating system 4) C.O.P of the system	
B	Explain summer and winter air-conditioning processes with the help of psychrometric chart.	
C	A Simple NH_3 vapour compression system has compressor with piston displacement of 3 m^3/min, a condenser pressure of 12 bar and evaporator pressure of 2,5 bar. The liquid is sub-cooled to 20°Cby soldering the liquid line to suction line. The temperature of vapour leaving the cooling water is 6000KJ/hr and volumetric efficiency of compressor is 0.8. Use PH Chart. Find: 1) Capacity of the system 2) Indicated power 3) COP of the system 4) Draw P-H and T-S Diagram	Temp of vapor leaving Compressor = 100°

Q4.		
A	**Solve any Two Questions out of Three**	**5 marks each**
i.	Write a note on ICE plant	
ii.	Dry bulb temperature =30°c Wet bulb temperature = 20°c Barometer reading = 740 mm of Hg Using steam table. Determine 1. Partial pressure of water vapour 2. Relative humidity 3. Dew point temperature 4. Specific humidity Vapour density	
iii.	Explain the use of heat pump for heating and cooling cycle with neat diagram.	
B	**Solve any One Question out of Two**	**10 marks each**
i.	The following data refers to the office of air conditioning plant having maximum seating capacity of 30 occupants. Outside design conditions: 36° CDBT and 27° CWBT Inside design conditions: 22° CDBT and 55% RH Solar heat gain: 8500 W Latent heat gain per occupant : 100 W	

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	Sensible heat gain per occupant : 83W Lightening load: 2500 W Sensible heat load from other sources : 12000 W Infiltration load: 15 m3/min 1) Assuming 40% fresh air and 60 % of recirculated air passing through the evaporator coil and the by-pass factor of 0.12, Find dew point temperature of the coil and capacity of the plant.
ii.	An air conditioning plant is required to supply 60 m^3 of air per minute at a Dry bulb temperature of 21 deg C and 55% Relative humidity. The outside air is at dry bulb temperature of 28 deg C and 60% relative humidity. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air