INSTITUTEOFAERONAUTICALENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**REFRIGERATION AND AIR CONDITIONING**				
Course Code	AME017				
Programme	B.Tech				
Semester	VII	ME			
Course Type	Core				
Regulation	**IARE - R16**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. A Somaiah, Assistant Professor				
Course Faculty	Mr. M Prashanth Reddy, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand vapor compression, vapor absorption and air refrigeration systems.
II	Analyze the refrigeration cycles and methods for improving the performance using standard data hand book with p-h charts.
III	Familiarize the components of refrigeration system.
IV	Identify various psychometric properties and processes.

COURSE OUTCOMES (COs):

CO 1	Describe the concept of vapor compression refrigeration, effect of sub cooling, super heating, construction of P-H charts.
CO 2	Understand the functions of various refrigeration components like, compressor, condenser, expansion valve and evaporator.
CO 3	Understand the working of vapour absorption refrigeration, it's components and air refrigeration systems.
CO 4	Explore the concept Psychometry, it's properties, RSHF, ESHF, GSHF and concept of human comfort and temperature.
CO 5	Classification of air conditioning equipment and description of heat pumps.

COURSE LEARNING OUTCOMES (CLOs):

AME017.01	Derive COP of HP, R & HE
AME017.02	Describe the working of Carnot refrigerator and its applications.
AME017.03	Describe the working of vapor compression refrigeration cycle.
AME017.04	Use the concept of random variables in real-world problem like graph theory; machine learning, Natural language processing.
AME017.05	Determine the binomial distribution to find mean and variance.
AME017.06	Demonstration of working of condensers.
AME017.07	Demonstration of working of evaporators.
AME017.08	Classifying and Demonstration of expansion devices.
AME017.09	Demonstration of Aqua-Ammonia VARS.
AME017.10	Illustration of Li-Br VARS.
AME017.11	Explanation of principle & Demonstration of Electrolux.
AME017.12	Discuss the air refrigeration cycles and its applications.
AME017.13	Discuss the various properties of air.
AME017.14	Draw and Calculate Various sensible heat factors.
AME017.15	Draw & Describe comfort and industrial air conditioning.
AME017.16	Calculate the air conditioning loads.
AME017.17	Classify the equipment of air conditioning.
AME017.18	Describe the importance of filters, grills, registers & Explain the working of fans and blowers.
AME017.19	Discuss the various heat pump sources.
AME017.20	Draw heat pump circuits and Discuss their applications.

TUTORIAL QUESTION BANK

UNIT - I				
INTRODUCTION TO REFRIGERATION				
Part - A (Short Answer Questions)				
S. No.	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	Define Unit of refrigeration.	Remember	CO 1	AME017.01
2	Define Coefficient of performance.	Understand	CO 1	AME017.01
3	What is the effect of sub cooling of liquid on the COP?	Remember	CO 1	AME017.01
4	What is the effect of super heating of vapor on the COP?	Remember	CO 1	AME017.01
5	Define Wet compression	Understand	CO 1	AME017.01
6	What is the effect of increase of suction pressure on COP?	Remember	CO 1	AME017.01
7	Define Dry compression	Understand	CO 1	AME017.02
8	What is the effect of decrease of delivery pressure on COP?	Remember	CO 1	AME017.02
9	What is a heat pump?	Understand	CO 1	AME017.02
10	A refrigerator operates between the temperatures of $-23^{O}C$ and $27\ ^{O}C$. Determine the minimum power required per ToR to operate the refrigerator.	Remember	CO 1	AME017.02
11	Draw the p-h diagram for sub cooling with dry compression.	Understand	CO 1	AME017.02
12	Discuss the governing law of refrigeration.	Remember	CO 1	AME017.03
13	Draw the T-S diagram for sub cooling with dry compression.	Understand	CO 1	AME017.03
14	Define sub cooling.	Understand	CO 1	AME017.03
15	What is superheat horn?	Remember	CO 1	AME017.03
16	Give some applications of refrigerator.	Understand	CO 1	AME017.03
17	Define refrigeration.	Understand	CO 1	AME017.04
18	What are the disadvantages of wet compression?	Remember	CO 1	AME017.04
19	Draw the p-h diagram for sub cooling with wet compression.	Understand	CO 1	AME017.04
20	Define refrigerant.	Remember	CO 1	AME017.04

Part - B (Long Answer Questions)

1	Describe the mechanism of a simple vapour compression refrigeration system.	Understand	CO 1	AME017.02
2	What are the important types of vapour compression cycles? Explain with the help of P-h diagram.	Remember	CO 1	AME017.02
3	The capacity of a refrigerator is 200 TR when working between -6^{0}C and 25^0 C. determine the mass of ice produced per day from water at 25^{0}C. Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and latent heat of ice is 335 KJ/Kg.J	Understand	CO 1	AME017.02
4	An ammonia refrigerator produces 30 tonnes of ice from and at 0^{0}C in 24 hours. The temperature range of the compressor is 25^{0}C to -15^{0}C. The vapour is dry saturated at the end of compression and an expression and an expansion value is used. Assume a coefficient of performance to be 60% of the theoretical value. Calculate the power required to drive the compressor. Latent heat of ice = 335 kJ/kg. Properties of ammonia are;	Understand	CO 1	AME017.02
5	Explain how you would detect whether a refrigerant is under charged or over charged.	Remember	CO 1	AME017.02
6	A R12 refrigerating machine works on a vapor compression cycle. The temperature of refrigerant in the evaporator is -20^{0}C. The vapor is dry saturated when it enters the compressor and leaves it in a superheated condition. The condenser temperature is 30^{0}C. Assuming Cp for R12 in the superheated condition as 1.884 KJ/Kg K, determine: i) Condition of vapor at the entrance to the condenser, ii) Condition of vapor at the entrance to the evaporator and iii) COP_{th} of the machine. Properties of R12	Understand	CO 1	AME017.03
7	What is the effect of sub-cooling on COP? Explain.	Understand	CO 1	AME017.03
8	A refrigeration system works on ammonia between pressure limits, 2.36 bar and 15.54 bar. If the refrigerant is sub cooled by 10k before throttling, determine the improvement in COP over simple vapor compression cycle.	Remember	CO 1	AME017.03
9	An ammonia ice plant operates between condenser temperature of 35^{0}C and an evaporator temperature of -15^{0}C. It produces 5 tonnes of ice per day from water at 25^{0}C to ice at -5^{0}C. The ammonia enters as dry saturated vapor and leaves the condenser as saturated liquid. Determine: a) The capacity of the refrigerating plant b) Mass flow of the refrigerant c) Discharge temperature of ammonia from the compressor d) Power of the compressor motor if the isentropic efficiency of the compressor is 85% and mechanical efficiency of the compressor is 90% e) Relative efficiency. The latent heat of formation of ice is 335 kj/kg and specific heat of ice is 2.1 kj/kg-k.	Understand	CO 1	AME017.03
10	Distinguish between dry and wet compression. What are the advantages of one over the other?	Understand	CO 1	AME017.03
11	A refrigerator using CO_2 as refrigerant works between the temperatures 17.5^{0}C and -17.5^{0}C. The CO_2 leaves the compressor at 30^{0}C. The gas is completely condensed but there is no under cooling. Calculate theoretical COP.	Remember	CO 1	AME017.03
12	Explain how you would detect whether a refrigerant is under charged or over charged.	Understand	CO 1	AME017.03
13	An ammonia refrigerator works between - 6.7^{0}C and 26^{0}C. The vapour leaves the compressor in dry and saturated condition. Assuming there is no under cooling; calculate the theoretical COP of the system.	Understand	CO 1	AME017.03
14	An ammonia refrigerator works between -6.7^{0}C and 26.7^{0}C, the vapor being dry	Remember	CO 1	AME017.03

Temperature ^{0}C	Enthalpy kJ/kg		Entropy kJ/kg	
	Liquid	Vapour	Liquid	Vapour
25	298.9	1465.84	1.1242	5.0391
-15	112.34	1426.54	0.4572	5.5490

Temp^{0}C	**h_f, KJ/Kg**	**h_g, KJ/Kg**	**S_f, KJ/Kg K**	**S_g, KJ/Kg K**
-20	17.82	178.73	0.0731	0.7087
30	64.59	199.62	0.2400	0.6843

<table>
<tr><td></td><td>at the end of isentropic compression. There is no under cooling of liquid ammonia and the liquid is expanded through a throttle valve after leaving the condenser. Sketch the cycle on the T-S and P-h diagram and calculate the refrigeration effect per Kg of ammonia and the theoretical COP of the unit with the help of properties given below.

<table>
<tr><td>Temp^{0}C</td><td>h_f, KJ/Kg</td><td>h_g, KJ/Kg</td><td>S_f, KJ/Kg K</td><td>S_g, KJ/Kg K</td></tr>
<tr><td>-6.7</td><td>152.18</td><td>1437.03</td><td>0.6016</td><td>5.4308</td></tr>
<tr><td>26.7</td><td>307.18</td><td>1467.03</td><td>1.1515</td><td>5.0203</td></tr>
</table></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td>Explain the effect of i) sub cooling of liquid and ii) superheat of vapor on the system performance.</td><td>Understand</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td>16</td><td>An ammonia refrigerating machine fitted with an expansion valve works between the temperature limits of -10^{0}C and 30^{0}C. The vapor is 95% dry at the end of isentropic compression and the fluid leaving the condenser is at 30^{0}C. Assuming actual COP as 60% of the theoretical, calculate the Kgs of ice produced per KW hour at 0^{0}C from water at 10^{0}C. Latent heat of ice is 335 KJ/Kg. ammonia has the following properties

<table>
<tr><td>Temp^{0}C</td><td>h_f, KJ/Kg</td><td>h_{fg}, KJ/Kg</td><td>S_f,KJ/Kg K</td><td>S_g, KJ/Kg K</td></tr>
<tr><td>30</td><td>323.08</td><td>1145.80</td><td>1.2037</td><td>4.9842</td></tr>
<tr><td>-10</td><td>135.37</td><td>1297.68</td><td>0.5443</td><td>5.4770</td></tr>
</table></td><td>Remember</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td>17</td><td>A refrigeration system works on ammonia between pressure limits, 2.36 bar and 15.54 bar. If the refrigerant is sub cooled by 10k before throttling, determine the improvement in COP over simple vapor compression cycle.</td><td>Understand</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td>18</td><td>Five hundred kgs of fruits are supplied to a cold storage at 20^{0}C. The cold storage is maintained at -5^{0}C and the fruits get cooled to the storage temperature in 10 hours. The latent heat of freezing is 105 kj/kg and specific heat of fruit is 1.256 kj/kg k. Find the refrigeration capacity of the plant.</td><td>Understand</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td>19</td><td>A machine working on a Carnot cycle operates between 305 K and 260 K. Determine the COP when it is operated as i) a refrigerator ii) a heat pump and a iii) a heat engine</td><td>Remember</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td>20</td><td>Derive an expression for COP of Carnot refrigerator and plot T-S and P-V diagrams of the cycle.</td><td>Understand</td><td>CO 1</td><td>AME017.03</td></tr>
<tr><td colspan="5">Part - C (Problem Solving and Critical Thinking Questions)</td></tr>
<tr><td>1</td><td>A Carnot refrigeration cycle absorbs heat at 270K and rejects it at 300K.
i. Calculate the COP of this refrigeration cycle.
ii. If the cycle is absorbing 1130 KJ/min. At 270 K, how many KJ of work is required per second?
iii. If the Carnot heat pump operates between the same temperatures as the above refrigeration cycle, what is the COP?
iv. How many kj/min will the heat pump deliver at 300K if it absorbs 1130 KJ/min at 270K.</td><td>Understand</td><td>CO 1</td><td>AME017.02</td></tr>
<tr><td>2</td><td>1.5kw per tonne of refrigeration is required to maintain the temperature of -40^{0}C in the refrigerator. If the refrigeration cycle works on carnot cycle, determine the following:
i. COP of the cycle
ii. temperature of the sink
iii. heat rejected to the sink per tonne of refrigeration
iv. heat supplied and EPR if the cycle is used as a heat pump.</td><td>Remember</td><td>CO 1</td><td>AME017.02</td></tr>
<tr><td>3</td><td>A vapour compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no under cooling of the liquid before the expansion valve. Determine: 1. COP of the the cycle and 2. Capacity of the refrigerator if the fluid flow is at the rate fo 5 Kg/min.</td><td>Understand</td><td>CO 1</td><td>AME017.02</td></tr>
</table>

	<table><tr><td rowspan="2">Pressure, bar</td><td rowspan="2">Sat.Temp.,K</td><td colspan="2">Enthalpy, Kj/Kg</td><td colspan="2">Entropy, Kj/Kg</td></tr><tr><td>Liquid</td><td>vapor</td><td>Liquid</td><td>vapor</td></tr><tr><td>60</td><td>295</td><td>151.96</td><td>293.29</td><td>0.554</td><td>1.0332</td></tr><tr><td>25</td><td>261</td><td>56.32</td><td>322.58</td><td>0.226</td><td>1.2464</td></tr></table>			
4	Establish with a neat p-h and T-S diagrams, how an actual cycle differs from a theoretical vapour compression cycle.		Understand	CO 1	AME017.03
5	Sketch the T-S and p-h diagrams for the vapour compression cycles when the vapour after compression is: i. Dry saturated ii. Wet iii. Super heated and iv. Wet before compression		Remember	CO 1	AME017.03
6	Five hundred Kgs of fruits are supplied to a cold storage at 20^0C. The cold storage is maintained at -5^0C and the fruits get cooled to the storage temperature in 10 hours. The latent heat of freezing is 105 KJ/Kg and specific heat of fruit is 1.256 KJ/Kg K. Find the refrigeration capacity of the plant.		Understand	CO 1	AME017.03
7	1.5 KW per ton of refrigeration is required to maintain the temperature of -40^0C in the refrigerator. If the refrigeration cycle works on Carnot cycle, determine the following: 1. COP of the cycle; 2. Temperature of the sink; 3. Heat rejected to the sink; 4. Heat supplied and EPR, if the cycle is used as a heat pump.		Understand	CO 1	AME017.03
8	The capacity of a refrigerator is 200TR when working between -6^0C and 25^0C. Determine the mass of ice produced per day from water at 25^0C. Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and latent heat of ice is 335 KJ/Kg.		Remember	CO 1	AME017.03
9	Establish how an actual cycle differs from a theoritical vapor compression cycle.		Understand	CO 1	AME017.03
10	Why in practice a throttle valve is used in vapor compression refrigerator rather than an expansion cylinder to reduce the pressure between the condenser and evaporator?		Remember	CO 1	AME017.03
	UNIT - II				
	VAPOUR ABSORPTION, STEAM JET REFRIGERATION AND REFRIGERANTS				
	Part – A (Short Answer Questions)				
1	Why the boiling point difference of absorbent-refrigerant should be high.		Understand	CO 2	AME017.05
2	What is the effect of latent heat of absorbent on performance of the absorption systems?		Remember	CO 2	AME017.07
3	What is the refrigerant in Li-Br and water absorption system?		Understand	CO 2	AME017.05
4	What is the refrigerant in Ammonia and water absorption system?		Understand	CO 2	AME017.07
5	What is the function of rectifier in Ammonia absorption system?		Remember	CO 2	AME017.05
6	What are the desirable requirements of a Refrigerant - Absorption pair?		Understand	CO 2	AME017.05
7	Name air refrigeration cycle and What are the processes of Air refrigeration cycle?		Remember	CO 2	AME017.07
8	If in an air refrigeration plant, the temperatures of air entering and leaving the expander are 300K and 200K respectively, determine the COP of the plant assuming isentropic compression and expansion.		Understand	CO 2	AME017.05
9	Which parts replace the function of compressor in absorption system?		Remember	CO 2	AME017.09
10	What are the three fluids used in Electrolux refrigeration?		Understand	CO 2	AME017.07
11	Define absorbent and adsorbent.		Understand	CO 2	AME017.09
12	What do you mean by the product of COP of refrigerator and heat engine?		Remember	CO 2	AME017.05
13	What is the other name of an Electrolux refrigerator?		Understand	CO 2	AME017.05
14	Who invented the Electrolux refrigerator principle?		Understand	CO 2	AME017.05
15	What is the role of hydrogen in Electrolux refrigerator?		Remember	CO 2	AME017.05
16	What is the absorbent in lithium bromide absorption system?		Understand	CO 2	AME017.09
17	What is the refrigerant in lithium bromide absorption system?		Remember	CO 2	AME017.07
18	What are the disadvantages of absorption refrigeration over compression system?		Understand	CO 2	AME017.05
19	What is the difference between 2-shell and 4-shell Li-Br absorption system?		Remember	CO 2	AME017.05
20	What is the function of absorber in the vapor absorption system?		Understand	CO 2	AME017.05
	Part - B (Long Answer Questions)				
1	Explain the working of a simple vapor absorption refrigeration system with a		Understand	CO 2	AME017.05

	neat sketch.			
2	What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems.	Remember	CO 2	AME017.07
3	Discuss the advantages of vapor absorption refrigeration system over vapor compression refrigeration system.	Understand	CO 2	AME017.07
4	Describe with a neat sketch the working of lithium Bromide (two shell) water absorption system.	Understand	CO 2	AME017.07
5	Describe with a neat sketch the working of lithium Bromide (Four shell) water absorption system.	Remember	CO 2	AME017.09
6	Explain the working of a practical Ammonia-water vapour absorption refrigeration system with neat sketch.	Understand	CO 2	AME017.09
7	Explain with neat sketch Domestic Electrolux Refrigerator, with the functions of hydrogen, ammonia and water in the three fluid refrigeration system.	Understand	CO 2	AME017.05
8	Explain the function of liquid-vapour heat exchanger between the generator and absorber and how it can improve the performance of the vapour absorption system.	Remember	CO 2	AME017.09
9	Derive an expression for the COP of vapor absorption refrigeration system.	Understand	CO 2	AME017.09
10	Calculate the COP of vapour absorption refrigeration system has the generator temperature of 80^0C, condenser temperature of 25^0C and an evaporator temperature of -10^0C.	Remember	CO 2	AME017.09
11	In an absorption refrigeration system heating, cooling and refrigeration takes place at the temperature of 150^0C, 30^0C and -20^0C. Find the theoretical COP of the system; if the heating temperature is increased to 200^0C and refrigeration temperature is decreased to -40^0C. Calculate the percentage of change in theoretical COP.	Understand	CO 2	AME017.05
12	Derive an expression for the C.O.P of a Bell-Coleman cycle refrigeration system.	Remember	CO 2	AME017.07
13	A refrigerator is working between the temperatures – 30^0C and 35^0C. What is the maximum possible COP of the refrigerator? If the actual COP is 75% of maximum, determine the refrigerating effect per KW of power input.	Understand	CO 2	AME017.07
14	Show that the coefficient of performance of an air cycle system is only a function of pressure ratio.	Understand	CO 2	AME017.09
15	An air refrigeration system operates with a cooler pressure 10 bar and refrigerator pressure 2 bar. The temperature of the air leaving the cooler is 25^0C and the air leaving the room is 3^0C. The compressor displacement is 30 cubic meter/min. Find i. Tons of refrigeration. ii. Power per ton. iii. Expander displacement in cum/min.	Remember	CO 2	AME017.07
16	A Bell - Coleman cycle works between 1 and 6 bar pressure limits. The compression and expansion indices are 1.25 and 1.3 respectively. Obtain COP and tonnage of the unit for an airflow rate of 0.5 kg/s. Neglect clearance volume and take temperature at the beginning of compression and expansion to be 7^0C and 37^0C, respectively.	Understand	CO 2	AME017.09
17	Refrigerator working on Bell-Coleman cycle operates between pressure limits of 1.05 bar and 8.5 bar. Air is drawn from the cold chamber at 10^0C, compressed and then is cooled to 30^0C, before entering the expansion cylinder. The expansion and compression follow the law, $PV^{1.3}$ = constant. Determine the theoretical cop of the system.	Understand	CO 2	AME017.05
18	In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5^0C, the condenser temperature is 40^0C, make up water is supplied at 20^0C. Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of entertainment and the efficiency of the thermo-compressor as 90%, 65% and 91% respectively. Determine: (a) Weight of steam required per hour per ton of refrigeration. (b) The volume of vapor removed from the flash chamber per hour per ton of refrigeration.	Remember	CO 2	AME017.07
19	Explain the principle and working of steam jet refrigeration system and the function of steam ejector with a neat sketch.	Understand	CO 2	AME017.09

20	Draw the temperature-entropy and enthalpy-entropy diagram of a steam jet refrigeration system and write the expressions for the following efficiencies; i. Nozzle ii. Entrainment and iii. Compression	Remember	CO 2	AME017.05
Part - C (Problem Solving and Critical Thinking Questions)				
1	Explain the function of ammonia, water and hydrogen in Electrolux refrigerator?	Understand	CO 2	AME017.07
2	Describe the working of steam jet refrigeration system with a neat sketch.	Remember	CO 2	AME017.07
3	Derive the expression for COP of aqua ammonia vapour absorption system with a neat sketch of simple VAS.	Understand	CO 2	AME017.09
4	A vapor compression cycle with ammonia as the refrigerant works between the limits of saturated suction temperature of -20^0C and saturated condensing temperature 30^0C. It is a simple saturated cycle and compression is isentropic; determine the work of compression per kg of ammonia. Compare the same, if ammonia vapor leaving the evaporator at -20^0C is absorbed by water so that the mass concentration in the solution reaches about 40%, and its solution is pumped to the condenser pressure. The specific volume of the solution may be assumed as 0.001161m^3/kg	Understand	CO 2	AME017.09
5	Sketch the steam jet refrigeration on T-s diagram and analyze the nozzle efficiency, entrainment efficiency, compression efficiency and mass of motive steam required.	Remember	CO 2	AME017.09
6	Differentiate between physical and thermodynamic properties of a refrigerant. Explain which are more important giving specific examples.	Understand	CO 2	AME017.05
7	Give azeotropic mixing refrigerants for the following refrigerants. Mention the chemical formula also. a. R-500 b. R-502 c. R-503 and d. R-504.	Understand	CO 2	AME017.05
8	Compare the refrigerants R-11, R-12, R22 and ammonia in regard of normal boiling point, compressors used, range of temperatures and type of application.	Remember	CO 2	AME017.09
9	Discuss from the economical point of view whether sulphur dioxide or carbon dioxide is preferred as refrigerant.	Understand	CO 2	AME017.09
10	How will you assign number to the refrigerants methyl chloride (CH_3Cl) and tetra-chloroethane ($C_2H_4Cl_4$).	Remember	CO 2	AME017.05
UNIT – III				
REFRIGERATOR COMPONENTS				
Part - A (Short Answer Questions)				
1	What do you mean by hermetically sealed compressor?	Remember	CO 3	AME017.09
2	What is the name of bank of tubes at the back of domestic refrigerator?	Remember	CO 3	AME017.10
3	What type of the compressor is used in domestic refrigerator?	Understand	CO 3	AME017.09
4	What do you mean by open type compressor?	Remember	CO 3	AME017.09
5	Give the classification of condensers.	Remember	CO 3	AME017.10
6	For small installations of refrigeration systems (up to 35kW) which type of condenser is used?	Understand	CO 3	AME017.10
7	What do you mean by overcharged?	Understand	CO 3	AME017.09
8	What do you mean by semi-hermetically sealed compressor?	Remember	CO 3	AME017.09
9	What do you mean by undercharging?	Understand	CO 3	AME017.09
10	Write the correct sequential order of the different components in VCR system starting from the Compressor.	Understand	CO 3	AME017.09
11	What is the function of accumulator in a flooded type evaporator refrigerator?	Understand	CO 3	AME017.12
12	Give the classification of expansion devices.	Remember	CO 3	AME017.11
13	What type of expansion devise is used in domestic refrigerator?	Remember	CO 3	AME017.11
14	Give the classification of condensers.	Understand	CO 3	AME017.12
15	What do you mean by bare tube coil evaporator?	Remember	CO 3	AME017.12
16	A capillary tube is used in a small refrigerator to serve the purpose of which component of the refrigerating system?	Remember	CO 3	AME017.11
17	Give the classification of evaporators.	Understand	CO 3	AME017.12
18	What do you mean by semi-hermetically sealed compressor?	Remember	CO 3	AME017.15
19	Which component of the vapor compression refrigeration system produces the	Remember	CO 3	AME017.12

	refrigeration effect?			
20	During which component of the VCR system, the enthalpy of the refrigerant remains constant?	Understand	CO 3	AME017.11
Part – B (Long Answer Questions)				
1	Classify the compressors and explain the working, advantages and disadvantages of reciprocating compressors with neat sketch.	Understand	CO 3	AME017.09
2	Classify the compressors and explain the working, advantages and disadvantages of centrifugal compressors with neat sketch.	Understand	CO 3	AME017.09
3	Classify the compressors and explain the working, advantages and disadvantages of rotary compressors with neat sketch.	Remember	CO 3	AME017.09
4	Classify the compressors and explain the working, advantages and disadvantages of screw compressors with neat sketch.	Understand	CO 3	AME017.09
5	Describe the hermetically and semi hermetically sealed compressors, also give their merits and demerits.	Understand	CO 3	AME017.09
6	With the help of a schematic diagram, explain the Working of air cooled condensers.	Remember	CO 3	AME017.10
7	With the help of a schematic diagram, explain the Working of water cooled condensers.	Understand	CO 3	AME017.10
8	With the help of a schematic diagram, explain the Working of evaporative condenser.	Remember	CO 3	AME017.10
9	Discuss the advantages and disadvantages of centrifugal compressors over reciprocating compressors.	Understand	CO 3	AME017.10
10	Discuss the advantages and disadvantages of air cooled compressors over water cooled compressors.	Remember	CO 3	AME017.10
11	Describe the working principle of shell and tube type evaporator with neat sketch.	Understand	CO 3	AME017.12
12	Describe the working principle of shell and coil type evaporator with neat sketch.	Remember	CO 3	AME017.12
13	a) What problems do lubricating oil causes in the evaporator? b) With a neat diagram, explain the function of flooded type evaporator.	Understand	CO 3	AME017.12
14	Explain the working of a dry expansion type evaporator with a neat sketch.	Understand	CO 3	AME017.12
15	Describe the working principle of bare tube coil, finned tube coil and plate type evaporators with neat sketches.	Remember	CO 3	AME017.12
16	Explain the working of natural convection and forced convection type evaporator, also discuss their merits and demerits.	Understand	CO 3	AME017.12
17	How do you identify the frosting, non-frosting and defrosting evaporators, explain.	Understand	CO 3	AME017.12
18	Explain the working of an automatic expansion valve with the help of a neat sketch.	Remember	CO 3	AME017.11
19	With the help of a schematic diagram, explain the functioning of thermostatic expansion valve.	Understand	CO 3	AME017.11
20	Describe the working principle of low side float valve, with a neat sketch.	Remember	CO 3	AME017.11
Part – C (Problem Solving and Critical Thinking)				
1	How do you select the compressor for particular application and give some refrigerants and compressor pairs.	Understand	CO 3	AME017.09
2	How do you select the condenser for particular application and the differences between air cooled, water cooled and evaporative condensers?	Remember	CO 3	AME017.10
3	Compare the performance of reciprocating and centrifugal refrigerant compressors.	Understand	CO 3	AME017.09
4	Describe the effect of suction temperature on the refrigerating capacity and brake power of a reciprocating compressor.	Understand	CO 3	AME017.09
5	Give the advantages and disadvantages of hermetically sealed, semi hermetically sealed and open type compressors.	Remember	CO 3	AME017.09
06	What are the differences between fixed opening type and varying opening type of expansion devices, also give some refrigerants and suitable materials pairs.	Understand	CO 3	AME017.11
07	How the length and diameter of the evaporator coils will affect the system performance, discuss?	Remember	CO 3	AME017.12

08	Differentiate between low side and high side float valve.	Understand	CO 3	AME017.11
09	Make a comparative study of flooded and non-flooded shell and tube type evaporators based on the capacity, condition of vapor leaving the evaporator, heat transfer effectiveness, construction and control.	Understand	CO 3	AME017.11
10	What are the factors that affect the heat transfer capacity of an evaporator also describe pool and flow boiling.	Understand	CO 3	AME017.12
UNIT - IV				
INTRODUCTION TO AIR CONDITIONING				
Part – A (Short Answer Questions)				
1	Define Air-conditioning.	Remember	CO 4	AME017.13
2	What is wet bulb temperature?	Remember	CO 4	AME017.14
3	Define degree of saturation	Remember	CO 4	AME017.15
4	Sketch the process of heating and humidification on psychometric chart.	Remember	CO 4	AME017.16
5	Define Relative humidity	Understand	CO 4	AME017.13
6	What is Apparatus Dew Point?	Remember	CO 4	AME017.14
7	Give the expression for Sensible Hea Factor.	Understand	CO 4	AME017.15
8	Define Dew Point Temperature.	Understand	CO 4	AME017.16
9	Sketch the process of cooling and humidification on psychometric chart.	Understand	CO 4	AME017.13
10	Define Dalton's Law.	Understand	CO 4	AME017.14
11	Sketch the process of sensible heating on psychometric chart.	Remember	CO 4	AME017.15
12	Define and plot cooling and dehumidification process on psychometric chart	Understand	CO 4	AME017.16
13	Draw the process of humidification on psychometric chart.	Understand	CO 4	AME017.13
14	Define and write the formula for BPF.	Understand	CO 4	AME017.14
15	Sketch the process of sensible cooling on psychometric chart.	Remember	CO 4	AME017.15
16	Draw the process of cooling and dehumidification on psychometric chart.	Understand	CO 4	AME017.16
17	Write any two major requirements of human comfort	Understand	CO 4	AME017.13
18	Sketch the process of heating and dehumidification on psychometric chart.	Remember	CO 4	AME017.14
19	List any two requirements of industrial air conditioning	Remember	CO 4	AME017.15
20	Sketch the process of dehumidification on psychometric chart.	Understand	CO 4	AME017.15
Part – B (Long Answer Questions)				
1	Ten grams of moisture per kg of dry air is removed from atmospheric air when it is passed through an air conditioning system and its temperature becomes 20^0C. The atmospheric conditions are 40^0C DBT and 60% RH. Calculate the following for the conditioned air. i. Relative humidity, ii. Wet-bulb temperature, iii. Dew point temperature, iv. Enthalpy change for the air. Assume standard atmospheric pressure.	Understand	CO 4	AME017.13
2	(a) When is dehumidification of air necessary and how it is achieved? (b) Represent the following process in a skeleton psychometric chart. i. Sensible cooling ii. Cooling and humidification iii. Adiabatic mixing of air streams.	Remember	CO 4	AME017.14
3	Define and explain with neat sketch i. Partial pressure of water vapour ii. DPT iii. RH and iv. Degree of saturation.	Understand	CO 4	AME017.15
4	a) Write a short note on the bypass factor of the cooling coils. b) The sensible heat factor of an air-conditioned room is 0.67. The condition of the air leaving the air-conditioned room is 27^0C DBT and 52% RH. The maximum permissible temperature difference between the inlet air and outlet air is 11^0C. If the quantity of air flow at the inlet of the room is 180m^3/min, then determine the sensible and latent heat load of air conditioned room.	Understand	CO 4	AME017.16
5	An air conditioned hall of 1100 m^3 volume is maintained at 22^0C DBT and 52% RH. When outdoor air conditions are 45^0C DBT and 26^0C WBT, the hall sensible heat load is 23kw. The fresh air is 22% of the total air supplied. The ADP of the cooling coil is 10^0C and its bypass factor is 0.12. Calculate a) The condition and flow rate of supply air b) The latent heat gain of the room c) The cooling capacity of the coil.	Remember	CO 4	AME017.13

6	The following data refer to an air conditioning system for industrial process for hot and wet summer conditions: outdoor conditions = 33^0C DBT and 78% RH, required conditions = 20^0C DBT and 73% RH, amount of out-door air supplied = 220 m^3/min, coil dew point temperature = 12^0C. If the required condition is achieved by first cooling and dehumidifying and then by heating, determine; (a) The capacity of the cooling coil and its by-pass factor. (b) The capacity of the heating coil and surface temperature of the heating coil if the by-pass factor is 0.18.	Understand	CO 4	AME017.16
7	Derive the expression for the following terms: i. Specific humidity ii. Relative humidity iii. Vapor density iv. Enthalpy of moist air.	Remember	CO 4	AME017.16
8	List out different sources that contribute to the sensible heat load of the room to be air conditioned and Explain the procedure to construct the RSHF line on a psychrometric chart.	Understand	CO 4	AME017.16
9	An air conditioned auditorium is to be maintained at 27^0C DBT and 60% RH. The ambient condition is 40^0C DBT and 30^0C WBT. The total sensible heat load is 100000 KJ/h and total latent heat load is 40000 KJ/h. 60% of the return air is recirculated and mixed with 40% of make-up air after the cooling coil. The condition of air leaving the cooling coil is at 18^0C. Determine: i. Room Sensible Heat Factor, ii. The condition of air entering the auditorium; iii. The amount of make-up air; Show the process on psychrometric chart.	Understand	CO 4	AME017.16
10	Define the "human comfort", and explain the factors which affect the human comfort.	Remember	CO 4	AME017.16
11	The air in a room is to be maintained at 19^0C and 54 % R.H. by air supplied at a temperature of 14^0C. The design out-door conditions are as follows: Sensible heat gain: 20000 kJ/hr, Latent heat gain: 4000 kJ/hr, Out-door conditions: 30^0C DBT and 42% R.H. The ratio of recirculated air to fresh air is fixed at 2.8: 1 by weight .The plant consists of direct expansion cooling coil and after-heater and a constant speed fan. Calculate: (a) The quantity of air supplied per minute in cubic meters (b) The load on refrigerating plant in tons of refrigeration assuming the bypass factor of the cooling coil 0.15 (c) The load on after - heater in kW.	Understand	CO 4	AME017.13
12	Why ventilation is required? Explain why different ventilation standards for different purposes are recommended.	Understand	CO 4	AME017.13
13	An air conditioned plant is to be designed for a small office for winter conditions: Outdoor conditions are 10^0C DBT and 8^0C WBT, required indoor conditions are 20^0C DBT and 60% RH, amount of air circulation is 0.3 m^3/min./person, seating capacity of the office is 50 persons. The required condition is achieved first by heating and then by adiabatic humidifying, determine; i. Heating capacity of the coil in KW and the surface temperature; if the by-pass factor of the coil is 0.32; and ii. Capacity of the humidifier.	Remember	CO 4	AME017.14
14	The atmospheric air at 180C DBT and 70% RH is supplied to the heating chamber at the rate of 120m^3/min. The leaving air has a temperature of 24^0C without change in its moisture contents. Determine the heat added to the air per minute and final RH of the air.	Understand	CO 4	AME017.15
15	What are the important considerations in the design of an air conditioning system?	Understand	CO 4	AME017.16
16	Give the classification of the effects of heat on human body? Explain briefly.	Remember	CO 4	AME017.13
17	Briefly explain the thermodynamics of human body.	Understand	CO 4	AME017.14
18	800 m^3/min. of recirculated air at 22^0C DBT and 10^0C DPT is to be mixed with 300 m^3/min. of fresh air at 30^0C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio and DPT of the mixture.	Understand	CO 4	AME017.15
19	The amount of air supplied to air conditioned hall is 300 m^3/min. The atmospheric conditions are 35^0C DBT and 55% RH. The required conditions are 20^0C DBT and 60% RH, determine, the sensible heat and latent heat removed from the air per minute. Also, find SHF for the system.	Remember	CO 4	AME017.13
20	120 m^3 of air per minute at 35^0C DBT and 50% R.H is cooled to 20^0C DBT by	Understand	CO 4	AME017.13

	passing through a cooling coil Determine the following i. R.H of out coming air and its WBT ii. Capacity of the cooling coil in tons of refrigeration iii. Amount of water vapor removed per hr. iv. ADP.			
	Part – C (Problem Solving and Critical Thinking)			
1	The outdoor summer design condition for a bank for 100 persons at a place is T_{db} = 310K and T_{wb}=300K. The required inside conditions are T_{db} = 295K and φ = 60%. The room sensible heat 400,000kJ/h. The room latent heat 2,00,000kJ/h. Ventilation requirement per person 0.0047m^3/h. The by-pass factor is 0.15. Evaluate (a) grand total heat (b) ESHF (c) apparatus dew-point (d) volume flow rate of dehumidified air.	Understand	CO 4	AME017.13
2	Define SHF and with neat sketch on psychometric chart explain the process of determination of SHF for a process.	Remember	CO 4	AME017.14
3	Define GSHF and RSHF and with neat sketch on psychometric chart explain the process of determination of GSHF and RSHF for a process.	Understand	CO 4	AME017.15
4	Define ESHF and with neat sketch on psychometric chart explain the process of determination of ESHF for a process.	Understand	CO 4	AME017.16
5	Explain in detail with neat sketch on psychometric chart the difference between DPT and ADP.	Remember	CO 4	AME017.13
6	The moist air at 30^0C DBT and 50% relative humidity enters a cooling coil at a rate of 300 m^3/min and leaves the coil at 10^0C in just saturated state. Find the amount of moisture addition or deletion and tons of refrigeration required.	Understand	CO 4	AME017.14
7	The make-up air at rate of 100 m^3/min from the environment having t_{db} = 40^0C and t_{wb} = 27^0C is mixed with 600 m^3/min of return air from the conditioned space having state t_{db} = 23^0C and relative humidity 50%. Compare dry and wet bulb temperatures and specific humidity of the mixture.	Understand	CO 4	AME017.15
8	What is fog? Show on the chart when two air streams yield fogged state of air and list two ways of removing moisture from air.	Remember	CO 4	AME017.16
9	Derive an expression for the by-pass factor in terms of relevant terms. What is its utility?	Understand	CO 4	AME017.13
10	Air with T_{db} = 30^0C contains 15 grams of moisture per kg of dry air. Calculate a) dew point, b) relative humidity, c) degree of saturation, d) specific humidity. Also determine as to what would be the enthalpy of this air.	Understand	CO 4	AME017.13
	UNIT - V			
	AIR CONDITIONING SYSTEMS			
	Part - A (Short Answer Questions)			
1	State the function of grills in Air conditioning system	Understand	CO 5	AME017.17
2	Differentiate between grill and register used in air conditioning system	Remember	CO 5	AME017.18
3	What is the difference between fan and blower in air conditioning system	Understand	CO 5	AME017.19
4	State the function of a humidifier	Remember	CO 5	AME017.20
5	What is the function of a dehumidifier	Remember	CO 5	AME017.17
6	State the disadvantages of axial flow fans?	Remember	CO 5	AME017.18
7	How dehumidification process is achieved by reducing the air temperature?	Understand	CO 5	AME017.19
8	What is the name of the process of drawing water in the form of fine mist for humidification process?	Understand	CO 5	AME017.20
9	What are the sources of heat for heat pumps?	Understand	CO 5	AME017.17
10	Define the term 'Throw'?	Understand	CO 5	AME017.18
11	Why do we use deodorants in Air conditioning?	Remember	CO 5	AME017.19
12	What are the common units used for the pressure developed by fans? Write the reason for expressing the pressure in those units.	Understand	CO 5	AME017.20
13	State principle of working of centrifugal fans?	Remember	CO 5	AME017.17
14	What is the significance of classifying the fans into Class I, II and III?	Understand	CO 5	AME017.18
15	State the principle of working of axial fans?	Remember	CO 5	AME017.19
16	What is the disadvantage of humidification process by injecting steam?	Understand	CO 5	AME017.20
17	How can the life of HEPA filters be improved?	Remember	CO 5	AME017.17
18	What is the difference between screen filters and fine filters?	Understand	CO 5	AME017.18
19	Define HEPA filters?	Remember	CO 5	AME017.19
20	What is meant by AHU? Give one example.	Understand	CO 5	AME017.20

Part - B (Long Answer Questions)				
1	What are the sources of heat in nature which can be used for heat pumps? Discuss about the performance of Heat pump when used with the different sources of heat. State the advantages and disadvantages in each case.	Understand	CO 5	AME017.17
2	Describe the working of the heat pump by drawing the circuit for Water to air design.	Remember	CO 5	AME017.18
3	Describe any two methods of humidification of air by atomizing the water into air, with simple line sketches.	Understand	CO 5	AME017.19
4	Briefly explain different methods used to remove the odours from the air?	Understand	CO 5	AME017.20
5	Which type of air cleaner would be selected for removing very small dirt particles and smoke from the air? Explain its working principle.	Remember	CO 5	AME017.17
6	Explain the principle of various dehumidification methods.	Understand	CO 5	AME017.18
7	Explain the process of desalination of sea water by using a heat pump with neat diagram.	Understand	CO 5	AME017.19
8	Explain the following heat pump circuits with a neat sketch Fixed refrigerant circuit design.	Remember	CO 5	AME017.20
9	Explain the following heat pump circuits with a neat sketch Water –to- water design.	Understand	CO 5	AME017.17
10	Explain the working principle of forward curved and back ward curved fans with neat sketches.	Remember	CO 5	AME017.18
11	Describe the working of the heat pump by drawing the circuit for Air to water design.	Understand	CO 5	AME017.19
12	Describe the use of heat pump for heating and cooling cycle with a neat sketch.	Understand	CO 5	AME017.20
13	What are the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier?	Remember	CO 5	AME017.17
14	Explain the advantages and disadvantages of viscous filters over dry filters.	Understand	CO 5	AME017.18
15	With the help of a neat diagram, explain the functioning of dry and wet filters.	Understand	CO 5	AME017.19
16	With the help of a diagram, explain the Air washer humidifier and state the advantages of this type.	Remember	CO 5	AME017.20
17	Explain the working principle of radial blade and propeller fans with neat sketches.	Understand	CO 5	AME017.17
18	Explain the working principle of Tube-axial and vane axial fans with neat sketches.	Understand	CO 5	AME017.18
19	Explain briefly pre filters and fine filters with neat sketches.	Remember	CO 5	AME017.19
20	Explain briefly Absolute filters and Electronic filters with neat sketches.	Understand	CO 5	AME017.20
Part – C (Problem Solving and Critical Thinking)				
1	The power required for heating a room with reverse cycle refrigeration is less than what is required for heating with electrical strip heaters. Explain how.	Understand	CO 5	AME017.17
2	The first row of a cooling coil in the air entry side may not sweat. Why?	Remember	CO 5	AME017.18
3	Explain the important role of air filters in air conditioning.	Understand	CO 5	AME017.19
4	Three way diverting valves are generally used, instead of two-way solenoid valves, in chilled water coils. Why?	Understand	CO 5	AME017.20
5	Why is balancing valve used in chilled water systems?	Remember	CO 5	AME017.17
6	What is the grille in air conditioning? How does it help in getting uniform air distribution?	Understand	CO 5	AME017.18
7	Explain with a neat sketch the working of a mechanical filter for the purification of air in air conditioning systems.	Understand	CO 5	AME017.19
8	Explain with a neat sketch the working of a electrostatic filter for the purification of air in air conditioning systems.	Remember	CO 5	AME017.20
9	What is the purpose of a dehumidifier in air conditioning system? Also explain the working of a dehumidifier with a neat sketch.	Understand	CO 5	AME017.17
10	List various types of heat pump circuits. Also explain anyone of the heat pump circuits with a neat diagram.	Remember	CO 5	AME017.18

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