INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**REFRIGERATION AND AIR CONDITIONING**				
Course Code	AME017				
Program	B. Tech				
Semester	SEVEN				
Course Type	CORE				
Regulations	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. A Somaiah, Assistant Professor				

COURSE OBJECTIVES:

Students will try to learn:	
I	The principles of thermodynamics in refrigeration and air conditioning, analyze the methods of refrigeration, recognize the necessity and ideal cycle of refrigeration.
II	The nomenclature of refrigerants, realize the desirable properties of refrigerants to probe their ozone depleting and global warming potential.
III	The working principles, limitations, maintenance of refrigeration and air conditioning equipment and study their impact on the performance of the system.
IV	The psychrometric relations, processes, utilize their principles to resolve cooling load calculations and design of air conditioning systems.

COURSE OUTCOMES:

At the end of the course the students should be able to:

Course Outcomes		**Knowledge Level (Bloom's Taxonomy)**
CO 1	**Relate** the performance of a vapour compression refrigeration cycles under specified inlet and outlet conditions.	Remember

CO 2	**Identify** the modifications required in an impossible reversed Carnot cycle to convert it into practical cycle for refrigeration applications.	Remember
CO 3	**Demonstrate** the working principle and coefficient of performance of a heat pump, heat engine and refrigerator.	Understand
CO 4	**Illustrate** the working principles, limitations of practical aqua ammonia, LiBr-Water and Electrolux vapour absorption refrigeration systems.	Understand
CO 5	**Analyze** theoritical, practical aircraft refrigeration and steam jet refrigeration cycles with T-S diagrams, by stating merits, limitations, etc.	Analyze
CO 6	**Discuss** the measures to protect the ozone layer through global control, eventually elimination of production and utilization of ozone depleting substances.	Understand
CO 7	**Classify** the equipment used for the refrigeration, air conditioning purposes with suitable materials and refrigerant pairs.	Analyze
CO 8	**Construct** the sensible heat factor lines, locate alignment circle and SHF scale on a psychrometric chart for the cooling load calculations of air conditioning systems.	Apply
CO 9	**Explain** thermal comfort conditions with respect to effective temperature, relative humidity, etc. and their impact on human comfort, productivity and health.	Apply
CO 10	**Distinguish** the equipment required for air conditioning systems, study the operating principles, safety controls employed in air conditioning systems.	Analyze
CO 11	**Apply** the principles of psychrometry to calculate and design the air conditioning systems for particular purpose.	Apply
CO 12	**Compare** the various heat pump circuits for heating, cooling purposes with suitable industrial applications.	Understand

MAPPING OF EACH CO WITH PO(s), PSO(s):

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

CO 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 8	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 9	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 11	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 12	-	2	-	2	-	-	-	-	-	-	-	-	2	-	-
TOTAL	25	15		4			3						7		
AVERAGE	**2.77**	**2.14**		**2.0**			**3.0**						**2.33**		

TUTORIAL QUESTION BANK

UNIT – I				
INTRODUCTION TO REFRIGERATION				
PART - A (SHORT ANSWER QUESTIONS)				
S. No	**QUESTIONS**	**Blooms Taxonomy Level**	**How does this Subsume the level below**	**Course Outcomes**
1	Define unit of refrigeration and obtain the value of 1TR.	Remember	----	CO 3
2	Define coefficient of performance and energy performance ratio.	Remember	----	CO 2
3	What is the effect of sub cooling of liquid on the COP?	Understand	The learner to understand the various parameters effects on the coefficient of performance of the refrigerator.	CO 1
4	Explain the effect of super heating of vapor on the COP?	Understand	The learner to recall the various parameters which will influence the system performance.	CO 1
5	Define wet compression in vapour compression refrigeration and show it on a chart.	Understand	The learner to name and sketch different cycles on the P-h chart for knowing the thermodynamic effect.	CO 1
6	Explain the effect of increase of suction pressure on COP?	Understand	The learner to relate the effects on system performance due to pressure variations.	CO 1
7	Define dry compression and show it on a chart.	Remember	----	CO 1
8	What is the effect of decrease of delivery pressure on COP?	Understand	The learner to know the pressure influence on system performance which leads to variations in refrigeration effect.	CO 1

9	Summarize the functions of a heat pump?	Understand	The learner to understand thermodynamics and relate the heat pump, refrigerator and engine.	CO 3
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.	Understand	The learner to understand the Carnot cycle and units of refrigeration.	CO 2
11	Show the skeleton of p-h diagram for sub cooling with dry compression.	Understand	The learner to draw the P-h chart for finding the various operating parameters in refrigerator	CO 1
12	What is the governing law of refrigeration?	Remember	----	CO 2
13	Show the skeleton the T-S diagram for sub cooling with dry compression.	Understand	The learner to draw and explain the process of sub cooling using T-s, P-h charts, etc.	CO 1
14	Define sub cooling and sketch it on a chart.	Remember	----	CO 1
15	What is superheat horn?	Remember	----	CO 1
16	Summarize the applications of a refrigerator.	Understand	The learner to describe the societal and industrial applications of a refrigerator.	CO 3
17	State modifications required to make reversed Carnot cycle into Bell Coleman cycle.	Remember	----	CO 2
18	What are the disadvantages of wet compression?	Understand	The learner to understand the merits, demerits, limitations and effects on system performance due to wet compression.	CO 1
19	Show the skeleton of p-h diagram for sub cooling with wet compression.	Understand	The learner to draw the P-h chart for finding the various operating parameters in refrigerator	CO 1
20	Sketch the T-S and P-v diagrams of Bell Coleman cycle.	Understand	The learner to draw the T-s and P-v chart for finding the various operating parameters in refrigerator.	CO 2
PART - B (LONG ANSWER QUESTIONS)				
1	Explain the mechanism of a simple vapour compression refrigeration system.	Understand	The learner to Understand the working mechanism of a refrigerator.	CO 1
2	What are the important types of vapour compression cycles? Explain with the help of P-h diagram.	Remember	----	CO 1
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	Apply	The learner to recall the formulae and concepts of refrigeration methods.	CO 2
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	Apply	The learner to find the type of vapor compression cycle and show it on a P-h chart for determination of power	CO 1

<table>
<tr><td></td><td>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;
<table>
<tr><th rowspan="2">Temperature ^{0}C</th><th colspan="2">Enthalpy kJ/kg</th><th colspan="2">Entropy kJ/kg</th></tr>
<tr><th>Liquid</th><th>Vapour</th><th>Liquid</th><th>Vapour</th></tr>
<tr><td>25</td><td>298.9</td><td>1465.84</td><td>1.1242</td><td>5.0391</td></tr>
<tr><td>-15</td><td>112.34</td><td>1426.54</td><td>0.4572</td><td>5.5490</td></tr>
</table></td><td></td><td>requirement.</td><td></td></tr>
<tr><td>5</td><td>Explain how you would detect whether a refrigerant is under charged or over charged.</td><td>Understand</td><td>The learner to understand the different charging levels of a refrigerant in the system.</td><td>CO 1</td></tr>
<tr><td>6</td><td>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
<table>
<tr><th>T^{0}C</th><th>h_f, KJ/Kg</th><th>h_g, KJ/Kg</th><th>S_f, KJ/Kg K</th><th>S_g, KJ/Kg K</th></tr>
<tr><td>-20</td><td>17.82</td><td>178.73</td><td>0.0731</td><td>0.7087</td></tr>
<tr><td>30</td><td>64.59</td><td>199.62</td><td>0.2400</td><td>0.6843</td></tr>
</table></td><td>Apply</td><td>The learner to identify the type of vapor compression cycle and draw it on a P-h chart to calculate different conditions.</td><td>CO 1</td></tr>
<tr><td>7</td><td>What is the effect of sub-cooling on COP? Explain.</td><td>Understand</td><td>The learner to understand the various system influencing parameters of refrigeration system.</td><td>CO 1</td></tr>
<tr><td>8</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>Apply</td><td>The learner to find the type of vapor compression cycle and show it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
<tr><td>9</td><td>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.

Calculate:
a) The capacity of the refrigerating plant
b) Mass flow of the refrigerant
c) Discharge temperature of ammonia from the</td><td>Analyze</td><td>The learner to identify the type of vapor compression cycle and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
</table>

<table>
<tr><td></td><td>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.</td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>Distinguish between dry and wet compression. What are the advantages of one over the other?</td><td>Analyze</td><td>The learner to describe the differences of wet and dry compressions and explain their effect on system performance.</td><td>CO 1</td></tr>
<tr><td>11</td><td>A refrigerator using CO_2 as refrigerant works between the temperatures 17.5^0C and -17.5^0C. The CO_2 leaves the compressor at 30^0C. The gas is completely condensed but there is no under cooling. Determine theoretical COP.</td><td>Apply</td><td>The learner to find the type of vapor compression cycle and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
<tr><td>12</td><td>Explain how you would detect whether a refrigerant is under charged or over charged.</td><td>Understand</td><td>The learner to understand the refrigerant levels in a refrigerator.</td><td>CO 1</td></tr>
<tr><td>13</td><td>An ammonia refrigerator works between - 6.7^0C and 26^0C. The vapour leaves the compressor in dry and saturated condition. Assuming there is no under cooling; calculate the theoretical COP of the system.</td><td>Apply</td><td>The learner to identify the type of vapor compression cycle and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
<tr><td>14</td><td>An ammonia refrigerator works between -6.7^0C and 26.7^0C, the vapor being dry 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><th>T^0C</th><th>h_f, KJ/Kg</th><th>h_g, KJ/Kg</th><th>S_f, KJ/Kg K</th><th>S_g KJ/Kg K</th></tr>
<tr><td>-6.7</td><td>152.18</td><td>1437.03</td><td>0.6016</td><td>5.430</td></tr>
<tr><td>26.7</td><td>307.18</td><td>1467.03</td><td>1.1515</td><td>5.020</td></tr>
</table></td><td>Apply</td><td>The learner to choose the suitable vapor compression cycle and draw it on a P-h chart to determine the COP of a system.</td><td>CO 1</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>The learner to understand the effects of sub cooling, super heating of vapor on refrigeration system.</td><td>CO 1</td></tr>
<tr><td>16</td><td>An ammonia refrigerating machine fitted with an expansion valve works between the temperature limits of -10^0C and 30^0C. The vapor is 95% dry at the end of isentropic compression and the fluid leaving the condenser is at 30^0C. Assuming actual COP as 60% of the theoretical, calculate the Kgs</td><td>Apply</td><td>The learner to select the type of vapor compression cycle which exactly matches the given conditions and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
</table>

<table>
<tr><td></td><td>of ice produced per KW hour at 0^0C from water at 10^0C. Latent heat of ice is 335 KJ/Kg. Ammonia has the following properties
<table>
<tr><th>T^0 C</th><th>h_f, KJ/Kg</th><th>h_{fg}, KJ/Kg</th><th>S_f, KJ/Kg K</th><th>S_g, KJ/Kg K</th></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></td><td></td><td></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>Apply</td><td>The learner to identify the type of vapor compression cycle and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
<tr><td>18</td><td>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. Calculate the refrigeration capacity of the plant.</td><td>Apply</td><td>The learner to find the type of vapor compression cycle which fits to the given condition and sketch it on a P-h chart to calculate the COP of a system.</td><td>CO 1</td></tr>
<tr><td>19</td><td>A machine working on a Carnot cycle operates between 305 K and 260 K. Calculate the COP when it is operated as i) a refrigerator ii) a heat pump and a iii) a heat engine</td><td>Analyze</td><td>The learner to recall the different cycles to match with given condition and determine COP of refrigerator, heat pump, etc.</td><td>CO 2</td></tr>
<tr><td>20</td><td>Derive an expression for the C.O.P of a Bell-Coleman cycle refrigeration system.</td><td>Apply</td><td>The learner to recall the Carnot refrigeration cycle and know the modifications required to make it practical.</td><td>CO 2</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>Apply</td><td>The learner to identify the type of vapor compression cycle which fits to the given condition and sketch it on a P-h chart to calculate the different parameters of a system.</td><td>CO 2</td></tr>
<tr><td>2</td><td>1.5kw per tonne of refrigeration is required to maintain the temperature of -400C in the refrigerator. If the refrigeration cycle works on Carnot cycle, determine the following:
i. COP of the cycle</td><td>Understand</td><td>The learner to recall the different cycles to match with given condition and determine the various parameters of a system.</td><td>CO 2</td></tr>
</table>

<table>
<tr><td></td><td>ii. temperature of the sink
iii. heat rejected to the sink per ton of refrigeration
iv. heat supplied and EPR if the cycle is used as a heat pump.</td><td></td><td></td><td></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 cycle and 2. Capacity of the refrigerator if the fluid flow is at the rate of 5 Kg/min.
<table>
<tr><th rowspan="2">P, bar</th><th rowspan="2">T, K</th><th colspan="2">Enthalpy, Kj/Kg</th><th colspan="2">Entropy, Kj/Kg</th></tr>
<tr><th>Liq.</th><th>Vap</th><th>Liq.</th><th>Vap</th></tr>
<tr><td>60</td><td>295</td><td>151.9</td><td>293.2</td><td>0.554</td><td>1.033</td></tr>
<tr><td>25</td><td>261</td><td>56.32</td><td>322.5</td><td>0.226</td><td>1.246</td></tr>
</table></td><td>Apply</td><td>The learner to specify the type of vapor compression cycle which fits to the given condition and draw it on a P-h chart to calculate the different parameters of a system.</td><td>CO 1</td></tr>
<tr><td>4</td><td>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 100C, compressed and then is cooled to 300C, before entering the expansion cylinder. The expansion and compression follow the law, $PV^{1.3}$ = constant. Determine the theoretical COP of the system.</td><td>Apply</td><td>The learner to recall the concepts of Bell Coleman air cycle for refrigeration and plot the T-s, P-V diagrams to determine the COP.</td><td>CO 2
CO 3</td></tr>
<tr><td>5</td><td>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 70C and 370C, respectively.</td><td>Apply</td><td>The learner to recall the concepts of Bell Coleman air cycle for refrigeration and plot the T-s, P-V diagrams to determine the COP.</td><td>CO 2</td></tr>
<tr><td>6</td><td>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. Calculate the refrigeration capacity of the plant.</td><td>Understand</td><td>The learner to understand the refrigeration, latent heat, specific heat, etc. to calculate the capacity of a system.</td><td>CO 2
CO 3</td></tr>
<tr><td>7</td><td>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, calculate 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.</td><td>Understand</td><td>The learner to recall the concept of Carnot cycle for refrigeration and plot the T-s, P-V diagrams to determine the COP.</td><td>CO 2
CO 3</td></tr>
<tr><td>8</td><td>The capacity of a refrigerator is 200TR when working between -6^0C and 25^0C. Determine the</td><td>Understand</td><td>The learner to recall the concepts of refrigeration, latent heat,</td><td>CO 2
CO 3</td></tr>
</table>

	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.		specific heat, etc. to calculate the capacity of a system.	
9	Establish how an actual cycle differs from a theoritical vapor compression cycle.	Apply	The learner to identify the difference between actual and ideal refrigeration cycles.	CO 1
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? Discuss.	Understand	The learner to describe the function of expansion devices used in refrigeration system.	CO 1
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.	Remember	----	CO 4
2	What is the effect of latent heat of absorbent on performance of the absorption systems?	Remember	----	CO 4
3	What is the refrigerant in Li-Br and water absorption system?	Remember	----	CO 4
4	What is the refrigerant in Ammonia and water absorption system?	Remember	----	CO 4
5	Explain the function of rectifier in Ammonia absorption system?	Understand	The learner to recall the aqua ammonia vapour absorption refrigeration system.	CO 4
6	What are the desirable requirements of a Refrigerant - Absorption pair?	Remember	----	CO 4
7	Name air refrigeration cycle and What are the processes of Air refrigeration cycle?	Remember	----	CO 4
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	The learner to know the expression for COP of a vapor absorption system and apply in given conditions.	CO 4
9	Which parts replace the function of compressor in absorption system?	Remember	----	CO 4
10	Explain the three fluids used in Electrolux refrigeration?	Understand	The learner to Understand the different vapor absorption refrigeration systems.	CO 4
11	Define absorbent and adsorbent.	Remember	----	CO 4
12	Explain the nomenclature of refrigerants.	Understand	The learner to derivations of chemical names to numbers and vice-versa of refrigerants.	CO 7
13	What is the other name of an Electrolux refrigerator?	Remember	----	CO 4
14	Who invented the Electrolux refrigerator principle?	Remember	----	CO 4
15	Discuss the role of hydrogen in Electrolux refrigerator?	Understand	The learner to describe the different vapor absorption refrigeration systems.	CO 4

16	What is the absorbent in lithium bromide absorption system?	Remember	----	CO 4
17	What is the refrigerant in lithium bromide absorption system?	Remember	----	CO 4
18	What are the disadvantages of absorption refrigeration over compression system?	Remember	----	CO 4
19	What is the difference between 2-shell and 4-shell Li-Br absorption system?	Remember	----	CO 4
20	Explain the function of absorber in the vapor absorption system?	Understand	The learner to name and recall the functions of each and every device used in vapor absorption refrigeration system.	CO 4
PART - B (LONG ANSWER QUESTIONS)				
1	Explain the working of a simple vapor absorption refrigeration system with a neat sketch.	Understand	The learner to name and explain the functions of each and every device used in vapor absorption refrigeration system with sketches.	CO 4
2	What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems.	Remember	----	CO 4
3	Discuss the advantages of vapor absorption refrigeration system over vapor compression refrigeration system.	Understand	The learner to know the difference between vapor absorption and compression refrigeration system.	CO 4
4	Describe with a neat sketch the working of lithium Bromide (two shell) water absorption system.	Understand	The learner to Understand the various vapor absorption refrigeration systems.	CO 4
5	Describe with a neat sketch the working of lithium Bromide (Four shell) water absorption system.	Understand	The learner to Understand the various vapor absorption refrigeration systems.	CO 4
6	Explain the working of a practical Ammonia-water vapour absorption refrigeration system with neat sketch.	Understand	The learner to discuss the various vapor absorption refrigeration systems.	CO 4
7	Explain with neat sketch Domestic Electrolux Refrigerator, with the functions of hydrogen, ammonia and water in the three fluid refrigeration system.	Understand	The learner to describe the various vapor absorption refrigeration systems.	CO 4
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.	Understand	The learner to Understand the working principle of aqua ammonia vapor absorption refrigeration system.	CO 4
9	Derive an expression for the COP of vapor absorption refrigeration system.	Apply	The learner to recall the different heat generation points to derive the COP of a vapor absorption refrigeration system.	CO 4
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.	Apply	The learner to know the expression for COP of a vapor absorption system and apply in given conditions.	CO 4
11	In an absorption refrigeration system heating, cooling and refrigeration takes place at the	Apply	The learner to know the expression for COP of a vapor	CO 4

	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.		absorption system and apply in given conditions.	
12	Differentiate between primary and secondary refrigerants, also state examples of each.	Understand	The learner to know the physical, chemical and thermodynamic properties of a refrigerant.	CO 4
13	Discuss the eco-friendly refrigerants to protect the ozone layer through global control, eventually elimination of production and utilization of ozone depleting substances.	Understand	The learner to know the physical, chemical and thermodynamic properties of a refrigerant and identify the ozone depleting refrigerants.	CO 6
14	Describe the phenomena of global warming potential and ozone depleting potential, state the values for typical refrigerants.	Understand	The learner to know the physical, chemical and thermodynamic properties of a refrigerant and identify the ozone depleting and global warming refrigerants.	CO 6
15	State the thermodynamic properties and derive the chemical name of: i) R11, ii) R21, iii) R40 and iv) R14.	Understand	The learner to recall the physical, chemical and thermodynamic properties of the refrigerant	CO 7
16	Explain the functions of an ejector in steam jet refrigeration system with neat sketch.	Understand	The learner to understand the types of refrigeration systems and explain the components of SJRS.	CO 5
17	Compare vapour compression refrigeration system with steam jet refrigeration system, state merits and demerits.	Analyze	The learner to recall the types of refrigeration systems and distinctions among them.	CO 5
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. Calculate: (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.	Analyze	The learner to identify various conditions on a T-S diagram and recall the efficiencies exists in steam jet refrigeration system.	CO 5
19	Explain the principle and working of steam jet refrigeration system and the function of steam ejector with a neat sketch.	Understand	The learner to understand the steam jet refrigeration system with functions of each component in it.	CO 5
20	Sketch the temperature-entropy and enthalpy-entropy diagram of a steam jet refrigeration system and write the expressions for the following efficiencies;	Apply	The learner to draw T-S diagram and derive the different efficiencies.	CO 5

	i. Nozzle ii. Entrainment and iii. Compression			
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)				
1	Explain the function of ammonia, water and hydrogen in Electrolux refrigerator?	Understand	The learner to recall the functions of three fluids used in Electrolux refrigeration system.	CO 4
2	Describe the working of steam jet refrigeration system with a neat sketch.	Understand	The learner to understand the steam jet refrigeration system with functions of each component in it.	CO 5
3	Derive the expression for COP of aqua ammonia vapour absorption system with a neat sketch of simple VARS.	Apply	The learner to recall the steam jet refrigeration system with functions of each component in it and sketch on T-S diagram to derive COP.	CO 4
4	Compare vapour compression refrigeration system, vapor absorption refrigeration system with steam jet refrigeration system also state merits and demerits.	Analyze	The learner to understand the classification of refrigeration systems and their working principles.	CO 4
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.	Understand	The learner to recall the steam jet refrigeration system with functions of each component in it and sketch on T-S diagram to derive COP.	CO 5
6	Differentiate between physical and thermodynamic properties of a refrigerant. Explain which are more important, giving specific examples.	Understand	The learner to identify the physical, chemical and thermodynamic properties of a refrigerant	CO 7
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	The learner to know the physical, chemical and thermodynamic properties of a refrigerant	CO 7
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.	Evaluate	The learner to relate the physical, chemical and thermodynamic properties of refrigerants.	CO 7
9	Discuss from the economical point of view whether sulphur dioxide or carbon dioxide is preferred as refrigerant.	Understand	The learner to know different refrigerants and their applications.	CO 7
10	How will you assign number to the refrigerants methyl chloride (CH_3Cl) and tetra-chloroethane ($C_2H_4Cl_4$).	Understand	The learner to recall the nomenclature of refrigerants.	CO 7
UNIT-III				
REFRIGERATOR COMPONENTS				
PART - A (SHORT ANSWER QUESTIONS)				
1	What do you mean by hermetically sealed compressor?	Remember	----	CO 7

2	What is the name of bank of tubes at the back of domestic refrigerator?	Remember	----	CO 7
3	What type of the compressor is used in domestic refrigerator?	Remember	----	CO 7
4	What do you mean by open type compressor?	Remember	----	CO 7
5	Give the classification of condensers.	Understand	The learner to understand the condenser types according to application point of view.	CO 7
6	For small installations of refrigeration systems (up to 35kW) which type of condenser is used?	Remember	----	CO 7
7	What do you mean by overcharged? Explain.	Remember	----	CO 7
8	What do you mean by semi-hermetically sealed compressor?	Remember	----	CO 7
9	What do you mean by undercharging? Explain.	Understand	The learner to know about filling of refrigerant according to the available level in the system.	CO 7
10	Write the correct sequential order of the different components in VCR system starting from the Compressor.	Understand	The learner to recall the working of vapor compression refrigeration system.	CO 7
11	What is the function of accumulator in a flooded type evaporator refrigerator?	Remember	----	CO 7
12	Give the classification of expansion devices.	Understand	The learner to know the working of expansion devices and their classification.	CO 7
13	What type of expansion devise is used in domestic refrigerator?	Remember	----	CO 7
14	Explain the function of an accumulator in flooded type evaporator.	Understand	The learner to recall the working of flooded type evaporator.	CO 7
15	What do you mean by bare tube coil evaporator?	Remember	----	CO 7
16	A capillary tube is used in a small refrigerator to serve the purpose of which component of the refrigerating system?	Remember	----	CO 7
17	Give the classification of evaporators.	Understand	The learner to know the working of evaporators and its types.	CO 7
18	What do you mean by semi-hermetically sealed compressor?	Remember	----	CO 7
19	Which component of the vapor compression refrigeration system produces the refrigeration effect?	Remember	----	CO 7
20	In which component of the VCR system, the enthalpy of the refrigerant remains constant?	Understand	The learner to understand the working of each component of vapor compression refrigeration system.	CO 7
PART – B (LONG ANSWER QUESTIONS)				
1	Classify the compressors and explain the working, advantages and disadvantages of reciprocating	Understand	The learner to understand the working principle and	CO 7

	compressors with neat sketch.		classification of compressors.	
2	Explain the working, advantages and disadvantages of centrifugal compressors with neat sketch.	Understand	The learner to recall the working principle and classify the compressors.	CO 7
3	Describe the working, advantages and disadvantages of rotary compressors with neat sketch.	Understand	The learner to know the working principle of compressor, classify the compressors and explain the features of rotary compressors.	CO 7
4	Discuss the working, advantages and disadvantages of screw compressors with neat sketch.	Understand	The learner to describe the working principle of screw compressor and classify the compressors.	CO 7
5	Describe the hermetically and semi hermetically sealed compressors, also give their merits and demerits.	Understand	The learner to know the classification of compressors based on their construction.	CO 7
6	With the help of a schematic diagram, explain the Working of air cooled condensers.	Understand	The learner to describe the working of air cooled condensers and classify the condensers.	CO 7
7	With the help of a schematic diagram, explain the Working of water cooled condensers.	Understand	The learner to discuss the working of water cooled condensers and classify the condensers.	CO 7
8	With the help of a schematic diagram, explain the Working of evaporative condenser.	Understand	The learner to know the working of air cooled condensers and classify the condensers.	CO 7
9	Explain the advantages and disadvantages of centrifugal compressors over reciprocating compressors.	Apply	The learner to understand the working principle of compressors and their classification.	CO 7
10	Discuss the advantages and disadvantages of air cooled condensers over water cooled condensers.	Understand	The learner to know the distinction between various types of condensers.	CO 7
11	Describe the working principle of shell and tube type evaporator with neat sketch.	Understand	The learner to understand the working of evaporators and their types.	CO 7
12	Describe the working principle of shell and coil type evaporator with neat sketch.	Understand	The learner to know the working of evaporators and their types	CO 7
13	a) What problems do lubricating oil causes in the evaporator? b) With a neat diagram, explain the function of flooded type evaporator.	Apply	The learner to explain the role of lubrication in the system and the working of evaporator types.	CO 7
14	Explain the working of a dry expansion type evaporator with a neat sketch.	Apply	The learner to know the working principles of evaporators and their types.	CO 7
15	Describe the working principle of bare tube coil, finned tube coil and plate type evaporators with neat sketches.	Understand	The learner to recall the working of evaporators, plot the sectional diagrams including their types.	CO 7
16	Explain the working of natural convection and forced convection type evaporator, also discuss their merits and demerits.	Apply	The learner to classify the evaporators and discuss the different types of evaporators.	CO 7

17	How do you identify the frosting, non-frosting and defrosting evaporators, explain.	Understand	The learner to understand the classification of evaporators based on operating conditions of the system.	CO 7
18	Explain the working of an automatic expansion valve with the help of a neat sketch.	Apply	The learner to describe the operation of an automatic expansion valve with its schematic diagram.	CO 7
19	With the help of a schematic diagram, explain the functioning of thermostatic expansion valve.	Understand	The learner to recall the function of an expansion device, classification and operation of thermal expansion valve.	CO 7
20	Describe the working principle of low side float valve, with a neat sketch.	Understand	The learner to understand the function of float valves in a low pressure side of the system.	CO 7
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	The learner to know the selection criteria of a compressor for certain purpose.	CO 7
2	How do you select the condenser for particular application and the differences between air cooled, water cooled and evaporative condensers?	Remember	----	CO 7
3	Compare the performance of reciprocating and centrifugal refrigerant compressors.	Understand	The learner to recall the working principle of compressors to distinguish.	CO 7
4	Describe the effect of suction temperature on the refrigerating capacity and brake power of a reciprocating compressor.	Understand	The learner to know the effects of suction pressure on the system performance.	CO 7
5	Give the advantages and disadvantages of hermetically sealed, semi hermetically sealed and open type compressors.	Remember	----	CO 7
6	What are the differences between fixed opening type and varying opening type of expansion devices, also give some refrigerants and suitable materials pairs.	Understand	The learner to know the classification of expansion devices and the working principles to identify the differences.	CO 7
7	How the length and diameter of the evaporator coils will affect the system performance, discuss?	Understand	The learner to understand the function of evaporators and their constructional details.	CO 7
8	Differentiate between low side and high side float valve.	Analyze	The learner to relate the different types of expansion devices.	CO 7
9	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.	Analyze	The learner to know the working principles of evaporators and understand various parameters which affects performance.	CO 7
10	What are the factors that affect the heat transfer capacity of an evaporator also describe pool and flow boiling.	Understand	The learner to know the variations in heat transfer capacity due to boiling types.	CO 7

UNIT-IV				
INTRODUCTION TO AIR CONDITIONING				
PART – A (SHORT ANSWER QUESTIONS)				
1	Define the term “Air-conditioning”.	Remember	----	CO 11
2	What is wet bulb temperature and how it differs from dry bulb temperature?	Remember	----	CO 11
3	Define degree of saturation and apparatus dew point.	Remember	----	CO 11
4	Sketch the process of heating and humidification on psychometric chart.	Understand	The learner to identify and draw the processes on psychrometric chart	CO 11
5	Define Relative humidity and absolute humidity.	Remember	----	CO 11
6	What is Apparatus Dew Point?	Remember	----	CO 11
7	Give the expression for Sensible Hea Factor.	Understand	The learner to know concept of sensible heat factor.	CO 11
8	Define Dew Point Temperature.	Remember	----	CO 11
9	Sketch the process of cooling and humidification on psychometric chart.	Understand	The learner to identify and draw the processes on psychrometric chart	CO 11
10	Define Dalton’s Law.	Remember	----	CO 11
11	Sketch the process of sensible heating on psychometric chart.	Understand	The learner to recognize and draw the processes on psychrometric chart	CO 11
12	Define and plot cooling and dehumidification process on psychometric chart	Remember	----	CO 11
13	Sketch the process of humidification on psychometric chart.	Understand	The learner to find and draw the processes on psychrometric chart	CO 11
14	Define and write the formula for BPF.	Remember	The learner to recall the definition of sensible and latent heats and bypass factor.	CO 11
15	Sketch the process of sensible cooling on psychometric chart.	Understand	The learner to recognize and draw the processes on psychrometric chart	CO 11
16	Draw the process of cooling and dehumidification on psychometric chart.	Understand	The learner to identify and draw the processes on psychrometric chart	CO 11
17	Write any two major requirements of human comfort	Remember	----	CO 11
18	Sketch the process of heating and dehumidification on psychometric chart.	Understand	The learner to detect and draw the processes on psychrometric chart	CO 11
19	List any two requirements of industrial air conditioning	Understand	The learner to revive the applications of air conditioning.	CO 11

20	Sketch the process of dehumidification on psychometric chart.	Understand	The learner to ascertain and draw the processes on psychrometric chart	CO 11
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	The learner to find the properties and processes of psychrometry and draw the processes on psychrometric chart.	CO 8
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.	Understand	The learner to understand the importance of a psychrometric processes and able to show on skeleton of psychrometric chart.	CO 8
3	Define and explain with neat sketch i. Partial pressure of water vapour ii. DPT iii. RH and iv. Degree of saturation.	Understand	The learner to recall the information regarding the psychrometric processes.	CO 11
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.	Apply	The learner to know the sensible heat, latent heat loads and bypass factor.	CO 8
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.	Analyze	The learner to find latent heat gain, mass flow rate and capacity of the cooling system.	CO 8
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	Analyze	The learner to locate different psychrometric properties on a chart and determine cooling capacity.	CO 8

	= 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.			
7	Derive the expression for the following terms: i. Specific humidity ii. Relative humidity iii. Vapor density iv. Enthalpy of moist air.	Understand	The learner to derive expressions for humidity, RH, enthalpy, etc.	CO 11
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	The learner to list the sources which influences sensible heat loads.	CO 11
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.	Apply	The learner to determine RSHF and show the processes on a chart.	CO 8
10	Define the "human comfort", and explain the factors which affect the human comfort.	Understand	The learner to define human comfort and factors influences the comfort.	CO 11
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.	Apply	The learner to calculate different heat loads.	CO 11
12	Why ventilation is required? Explain why different ventilation standards for different purposes are recommended.	Understand	The learner to define human comfort and factors influences the comfort.	CO 11

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.	Apply	The learner to determine heating capacity of coil and BPF.	CO 9
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.	Apply	The learner to determine heat added to the air and relative humidity.	CO 9
15	Explain, the important considerations in the design of an air conditioning system?	Understand	The learner to know important considerations in design of A.C system.	CO 11
16	Give the classification of the effects of heat on human body? Explain briefly.	Understand	The learner to classify heat effects on human body.	CO 9
17	Briefly explain the thermodynamics of human body.	Understand	The learner to know the thermodynamics of human body.	CO 9
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.	Apply	The learner to determine enthalpy, specific volume, humidity ratio and DPT of the air mixture.	CO 11
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.	Apply	The learner to find sensible heat, latent heat removed from the air and SHF for the system.	CO 11
20	120 m^3 of air per minute at 35^0C DBT and 50% R.H is cooled to 20^0C DBT by passing through a cooling coil. Calculate 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.	Analyze	The learner to find dew point, RH, specific humidity and enthalpy.	CO 11
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.	Apply	The learner to draw RSHF, GSHF and ERSHF lines on a psychrometric chart.	CO 11

	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.			
2	Define SHF and with neat sketch on psychometric chart explain the process of determination of SHF for a process.	Understand	The learner to define sensible heat factor and sketch on a psychrometric chart.	CO 8
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	The learner to concept of GSHF and RSHF and sketch on a chart.	CO 8
4	Define ESHF and with neat sketch on psychometric chart explain the process of determination of ESHF for a process.	Understand	The learner to define the ESHF and sketch it a chart.	CO 8
5	Explain in detail with neat sketch on psychometric chart the difference between DPT and ADP.	Understand	The learner to concept of DPT and ADP and locate on a chart.	CO 8
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.	Apply	The learner to find amount of moisture addition or deletion and tons of refrigeration required.	CO 11
7	The make-up air at rate of 100 m^3/min from the environment having $t_{db} = 40^0$C and $t_{wb} = 27^0$C is mixed with 600 m^3/min of return air from the conditioned space having state $t_{db} = 23^0$C and relative humidity 50%. Compare dry and wet bulb temperatures and specific humidity of the mixture.	Apply	The learner to differentiate dry and wet bulb temperatures and specific humidity of the mixture.	CO 11
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	The learner to define fog and identify the region over a chart.	CO 11
9	Derive an expression for the by-pass factor in terms of relevant terms. What is its utility?	Understand	The learner to define and derive BPF and state the importance of it.	CO 11
10	Air with Tdb = 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.	Apply	The learner to calculate dew point, relative humidity, degree of saturation and specific humidity	CO 11
UNIT-V				
AIR CONDITIONING SYSTEMS				
PART – A (SHORT ANSWER QUESTIONS)				
1	State the function of grills in Air conditioning system	Remember	----	CO 10
2	Differentiate between grill and register used in air conditioning system	Understand	The learner to differentiate between grills and registers for A.C system	CO 10
3	What is the difference between fan and blower in air conditioning system	Remember	----	CO 10
4	State the function of a humidifier	Remember	----	CO 10

5	What is the function of a dehumidifier	Remember	----	CO 10
6	State the disadvantages of axial flow fans?	Remember	----	CO 10
7	How dehumidification process is achieved by reducing the air temperature?	Understand	The learner to know how dehumidification process is achieved.	CO 10
8	What is the name of the process of drawing water in the form of fine mist for humidification process?	Understand	The learner to name the process of drawing water in the form of fine mist for humidification process.	CO 10
9	What are the sources of heat for heat pumps?	Understand	The learner to list the sources of heat for heat pumps in nature.	CO 10
10	Define the term 'Throw'?	Understand	----	CO 10
11	Why do we use deodorants in Air conditioning?	Remember	----	CO 10
	What are the common units used for the pressure developed by fans? Write the reason for expressing the pressure in those units.	Understand	The learner to state the units for the pressure developed by fans.	CO 10
12	State principle of working of centrifugal fans?	Remember	----	CO 10
13	What is the significance of classifying the fans into Class I, II and III?	Understand	The learner to know the classifying significance of fans.	CO 10
14	State the principle of working of axial fans?	Remember	----	CO 10
15	What is the disadvantage of humidification process by injecting steam?	Understand	The learner to know the disadvantages of humidification process by injecting steam.	CO 10
16	How can the life of HEPA filters be improved?	Remember	----	CO 10
17	What is the difference between screen filters and fine filters?	Remember	----	CO 10
18	Define HEPA filters?	Remember	----	CO 10
19	What is meant by AHU? Give one example.	Remember	----	CO 10
20	State the function of grills in Air conditioning system	Remember	----	CO 10
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	The learner to list the sources of heat in nature and state the merits and demerits.	CO 12
2	Describe the working of the heat pump by drawing the circuit for water to air design.	Understand	The learner to know the working of the heat pump and draw the circuit for water to air design.	CO 12
5	Describe any two methods of humidification of air by atomizing the water into air, with simple line sketches.	Understand	The learner to categories of humidification of air by atomizing the water into air and able to sketch.	CO 10
6	Briefly explain different methods used to remove	Understand	The learner to know different	CO 12

	the odours from the air?		approaches to clean the air.	
7	Which type of air cleaner would be selected for removing very small dirt particles and smoke from the air? Explain its working principle.	Understand	The learner to select air cleaner to remove air in the particular purpose.	CO 12
8	Explain the principle of various dehumidification methods.	Understand	The learner to list the various dehumidification methods in air conditioning systems.	CO 12
9	Illustrate the process of desalination of sea water by using a heat pump with neat diagram.	Apply	The learner to demonstrate the heat pump for desalination of sea water.	CO 12
10	Describe the following heat pump circuits with a neat sketch, fixed refrigerant circuit design.	Understand	The learner to label the various heat pump circuits with their sketches.	CO 12
11	Sketch water –to- water design type of heat pump circuit and demonstrate the working principle.	Understand	The learner to demonstrate the heat pump circuit of water to water design.	CO 12
12	Discuss the working principle of forward curved and back ward curved fans with neat sketches.	Understand	The learner to know the working principle of forward curved and back ward curved fans.	CO 12
13	Describe the working of the heat pump by drawing the circuit for air to water design.	Understand	The learner to recall the working principle of air to water design.	CO 12
14	Explain the use of heat pump for heating and cooling cycle with a neat sketch.	Understand	The learner to know the description of heat pump for heating and cooling purposes.	CO 12
15	Write the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier?	Apply	The learner to state the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier.	CO 10
16	Explain the advantages and disadvantages of viscous filters over dry filters.	Apply	The learner to list the advantages and disadvantages of viscous filters.	CO 10
17	With the help of a neat diagram, explain the functioning of dry and wet filters.	Understand	The learner to know the working of dry and wet filters.	CO 10
18	With the help of a diagram, explain the Air washer humidifier and state the advantages of this type.	Apply	The learner to understand the working of air washer humidifier.	CO 10
19	Describe the working principle of radial blade and propeller fans with neat sketches.	Remember	The learner to know the working of radial blade and propeller fans.	CO 10
20	Illustrate the working principle of Tube-axial and vane axial fans with neat sketches.	Apply	The learner to demonstrate the working of Tube-axial and vane axial fans.	CO 10
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.	Apply	The learner to recall the second law of thermodynamics	CO 12
2	The first row of a cooling coil in the air entry side may not sweat. Why?	Remember	---	CO 10
3	Explain the important role of air filters in air conditioning.	Understand	The learner to understand the working of air filters	CO 10
4	Three way diverting valves are generally used, instead of two-way solenoid valves, in chilled water coils. Why?	Understand	The learner to define the working of valves.	CO 10

5	Explain, why is balancing valve used in chilled water systems?	Apply	The learner to relate the working of valves.	CO 10
6	Describe the function of a grille in air conditioning? How does it help in getting uniform air distribution?	Understand	The learner to recall working of air conditioning.	CO 10
7	Illustrate with a neat sketch the working of a mechanical filter for the purification of air in air conditioning systems.	Apply	The learner to understand the working of air filters.	CO 10
8	Explain with a neat sketch the working of an electrostatic filter for the purification of air in air conditioning systems.	Apply	This would require the learner to recall the working principles of air filters.	CO 10
9	Discuss the purpose of a dehumidifier in air conditioning system? Also explain the working of a dehumidifier with a neat sketch.	Understand	The learner to define the dehumidifiers and its practical applications.	CO 10
10	List various types of heat pump circuits. Also explain anyone of the heat pump circuits with a neat diagram.	Remember	---	CO 12

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