S. No	Question	Blooms Taxonomy Level	Course Outcome
	UNIT - I		
1	(a) Derive an expression for the C.O.P of a Bell-Coleman cycle refrigeration system. (b) 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.	Application, Synthesis	1
2	The cockpit of a jet plane is maintained at 25^0C using air cycle refrigeration system. The ambient air temperature and pressure are -15^0C and 0.4 bar respectively. The pressure ratio of the jet compressor is 3. The plane moves at a speed of 1500 km/hr. The air passes through a heat exchanger after compression and cooled to its original condition entering into the air jet. The pressure loss in the heat exchanger is 0.1 bar. The pressure of the air leaving the cooling turbine is 1.06 bar and the air pressure in the cabin is 1.013 bar. The cooling load in the cockpit is 70 kW. Determine the following, (a) Stagnation temperature and pressure (b) Mass flow rate of the air circulated through the cabin (c) Volume handled by the compressor and the expander	Application	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
	(d) COP of the system		
3	(a) Show that the coefficient of performance of an air cycle system is only a function of pressure ratio. (b) 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.	Application	1
4	(a) Describe briefly a simple aircraft refrigeration system. (b) 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.	Comprehension, Application	1
5	An air craft moving with a speed of 1000 KMPH uses simple air refrigeration cycle for air conditioning. The ambient pressure and temperature are 0.35 bar -10^0C respectively. The pressure ratio of the compressor is 4.5. The heat exchanger effectiveness is 0.95. The isentropic efficiencies of the compressor and expander are 0.8 each. The cabin pressure and temperature are 1.06 bar and 25^0C. Determine the temperatures and pressures at all states of the cycle. Also find the volume flow rate through compressor inlet and expander outlet for 100 TR. Take C_p= 1.005 kJ/hg-k and γ = 1.4 for air.	Application	1
6	a) With the help of a neat diagram, explain the functioning of boot strap air refrigeration system. b) 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.	Comprehension, Application	1
7	a) With the help of a neat diagram, explain the functioning of boot- strap air refrigeration system. b) 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.	Comprehension, Application	1
8	a) Explain the working of a simple air cooling system with a neat sketch also derive its COP. b) 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	Comprehension, Application	1
9	a) Derive an expression for COP of Carnot refrigerator and plot T-S and P-V diagrams of the cycle. b) The capacity of a refrigerator is 200 TR when working between -6^0C and 25^0 C. 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.J	Application, Synthesys	1
10	a) Explain the working of boot strap air evaporative cooling system with a neat sketch and derive the expression for its COP.	Comprehension, Application	1

<table>
<tr><th>S. No</th><th>Question</th><th>Blooms Taxonomy Level</th><th>Course Outcome</th></tr>
<tr><td></td><td>b) 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></td><td></td></tr>
<tr><td colspan="4">UNIT – II</td></tr>
<tr><td>1</td><td>(a) Describe the mechanism of a simple vapour compression refrigeration system.
(b) What are the important types of vapour compression cycles? Explain with the help of P-h diagram.</td><td>Comprehension, Evaluation</td><td>3</td></tr>
<tr><td>2</td><td>(a) Under what circumstances superheating of refrigerant vapour before compression is objectionable?
(b) An ammonia refrigerator produces 30 tonnes of ice from and at 0^0C in 24 hours. The temperature range of the compressor is 25^0C to -15^0C. 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;
<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>Evaluation, Application</td><td>3</td></tr>
<tr><td>3</td><td>a) Explain how you would detect whether a refrigerant is under charged or over charged.
b) A R12 refrigerating machine works on a vapor compression cycle. The temperature of refrigerant in the evaporator is -20^0C. The vapor is dry saturated when it enters the compressor and leaves it in a superheated condition. The condenser temperature is 30^0C. 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
<table>
<tr><th>Temp^{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>
entrance to the evaporator and iii) COP_{th} of the machine. Properties of R12</td><td>Comprehension, Application</td><td>3</td></tr>
<tr><td>4</td><td>a) What is the effect of sub-cooling on COP? Explain.
b) 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>Evaluation , Application</td><td>3</td></tr>
<tr><td>5</td><td>monia ice plant operates between condenser temperature of
nd an evaporator temperature of -15^0C. It produces 5 tonnes of
day from water at 25^0C to ice at -5^0C. The ammonia enters as
urated vapor and leaves the condenser as saturated liquid.
ine: 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.</td><td>Application</td><td>3</td></tr>
<tr><td>6</td><td>(a) Distinguish between dry and wet compression. What are the advantages of one over the other?
(b) A refrigerator using CO_2 as refrigerant works between the</td><td>Analysis, Application</td><td>3</td></tr>
</table>

<table>
<tr><th>S. No</th><th>Question</th><th>Blooms Taxonomy Level</th><th>Course Outcome</th></tr>
<tr><td></td><td>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.</td><td></td><td></td></tr>
<tr><td>7</td><td>(a) Explain how would you detect whether a refrigerant is under charged or over charged.
(b) 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.</td><td>Evaluation , Application</td><td>3</td></tr>
<tr><td>8</td><td>a) An ammonia refrigerator works between -6.7^{0}C and 26.7^{0}C, 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><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>
b) Explain the effect of i) sub cooling of liquid and ii) superheat of vapor on the system performance.</td><td>Application , Evaluation</td><td>3</td></tr>
<tr><td>9</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>Application</td><td>3</td></tr>
<tr><td>10</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.
<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></td><td>Application</td><td>3</td></tr>
<tr><td colspan="4">UNIT - III</td></tr>
<tr><td>1</td><td>(a) Explain the working of a automatic expansion valve with the help of a neat sketch.
(b) Describe the working of shell and tube type and shell and coil type evaporators.</td><td>Application , Comprehension</td><td>3, 4</td></tr>
<tr><td>2</td><td>(a) What is a refrigerant? Can water be used as refrigerant?</td><td>Knowledge,</td><td>3, 4</td></tr>
</table>

S. No	Question	Blooms Taxonomy Level	Course Outcome
	(b) Name three refrigerants that are suitable for ice plants giving their relative merits and demerits. (c) What are azeotropes?	Comprehension	
3	a) What problems does a lubricating oil causes in the evaporator. b) With a neat diagram, explain the function of flooded type evaporator.	Analysis, Comprehension	3, 4
4	a) With the help of a schematic diagram, explain the functioning of thermostatic expansion valve. (b) With the help of neat diagram, explain the working principle of shell and tube evaporators.	Comprehension	3, 4
5	Discuss the importance of boiling point and freezing point of following refrigerants with particular reference to their applications. R-11, R-12, R-13, R-22 and R-717.	Synthesis	3, 4
6	(a) Explain the potential of alternative refrigerants such as HFCs and HCFCs. (b) What are natural refrigerants? Discuss their potentials and limitations.	Comprehension, Synthesis	3, 4
7	a) Give azeotropic mixing refrigerants for the following refrigerants. Mention the chemical formula also. i. R500 ii. R502 iii. R503 iv. R504 b) What is the nomenclature of the refrigerants and derive the chemical formula for the refrigerants. i) R114 and ii) R22	Knowledge	3, 4
8	a) State the thermodynamic and safe working properties of an ideal refrigerant b) Explain the working principle of a high side float valve with a neat diagram.	Knowledge, Comprehension	3, 4
9	a) Derive the refrigerant numbers of following chemicals i. CF_4 ii. $CHCl_2F$ iii. CH_3Cl iv. C_2ClF_5 b) Explain the working principle of an automatic expansion valve with a neat sketch.	Synthesis, Comprehension	3, 4
10	a) Explain ozone depleting potential and global warming potential. b) With the help of neat diagram, explain the working principle low side float valve.	Comprehension	3, 4
	UNIT – IV		
1	(a) Describe with neat sketch working of lithium Bromide (two shell)-water absorption system. (b) What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems.	Comprehension , knowledge	3
2	(a) What modifications are necessary in a simple absorption refrigeration system in order to improve the COP of the system. (b) Explain with neat sketch Domestic Electorlux Refrigerator.	Synthesis, Comprehension	3
3	(a) Explain the working of a practical Ammonia-water vapour absorption refrigeration system. (b) What is the function of the rectifier and the analyzer in Ammonia-water vapour absorption refrigeration?	Comprehension, Analysis	3
4	(a) Why the boiling point difference of absorbent-refrigerant should be high. (b) What is the effect of latent heat of absorbent on performance of the absorption systems? (c) What are the desirable requirements of a Refrigerant - Absorption pair?	Analysis, Knowledge	3
5	a) Explain how the function of compressor in vapor compression system is achieved in vapor absorption refrigeration system.	Analysis Synthesis,	3

S. No	Question	Blooms Taxonomy Level	Course Outcome
	uss the advantages of vapor absorption refrigeration system apor compression refrigeration system. c) What modifications are necessary in a simple absorption refrigeration system in order to improve the performance of the system?		
6	a) 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. (b) 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.	Analysis, Application	3
7	Describe with neat sketch, the working of lithium Bromide (Four shell) - water absorption system.	Comprehension	3
8	a) Explain the functions of hydrogen, ammonia and water in three fluid refrigeration system. b) In an absorption type refrigeration system heating, cooling and refrigeration are carried out at temperatures of 197^0C, 17^0C and -3^0C respectively. Determine the maximum COP of the system.	Analysis, Application	3
9	a) Derive an expression for the COP of vapor absorption refrigeration system. b) 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.	Synthesis, Application	3
10	Explain the working of a simple vapor absorption refrigeration system with a neat sketch	Comprehension	3
	UNIT – V		
1	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 vapour removed from the flash chamber per hour per ton of refrigeration.	Application	1
2	(a) What are the merits of steam jet refrigeration system over other system? (b) Explain the working of thermo electric refrigerator, with a neat sketch?	Comprehension, Knowledge	1
3	(a) Explain the working of steam jet refrigeration system with a neat sketch. (b) Explain the Seebeck and Peltier effects.	Comprehension	1
4	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, and 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 vapour removed from the flash chamber per hour per	Application	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
	ton of refrigeration.		
5	a) What is the situation under which the steam jet refrigeration system is recommended? What are its limitations? Can it be used for obtaining sub zero temperatures? b) Explain the working principle of vortex tube and prove that the energy exchange phenomenon in vortex tube is not a violation of second law of thermodynamics.	Comprehension, Knowledge	1
6	a) Derive an expression for mass of motive steam required per kg of flash vapour. b) What are the various applications of thermo electric refrigerator?	Synthesis, Knowledge	1
7	a) 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 b) Explain the principle and operation of thermoelectric refrigerator with a neat sketch.	Analysis, Comprehension	1
8	a) What are the advantages of thermoelectric refrigeration system? b) Compare the thermoelectric refrigeration and vapour compression refrigeration system.	Knowledge, Comprehension	1
9	a) Explain the function of steam ejector in steam jet refrigeration system, with a neat sketch. b) What is the principle of steam jet refrigeration system?	Comprehension, Knowledge	1
10	a) What are the limitations of steam jet refrigeration system? b) What are the advantages of barometric condenser over surface condenser in steam jet refrigeration system?	Knowledge, Comprehension	1
	UNIT – VI		
1	(a) Represent the following process in a skeleton psychrometric chart. i. Sensible cooling ii. Cooling and humidification iii. Adiabatic mixing of air streams. (b) 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.	Analysis, Application	2, 4
2	(a) When is dehumidification of air necessary and how it is achieved? (b) 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 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.	Application	2, 4
3	(a) Define i. Partial pressure of water vapour ii. DPT iii. RH and iv. Degree of saturation. (b) 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.	Knowledge, Application	2, 4

S. No	Question	Blooms Taxonomy Level	Course Outcome
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.	Knowledge , Application	2, 4
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.	Application	2, 4
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.	Application	2, 4
7	Derive the expression for the following terms: i. Specific humidity ii. Relative humidity iii. Vapor density iv. Enthalpy of moist air.	Synthesis	2, 4
8	a) Explain the procedure to construct the RSHF line on a psychrometric chart. b) 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.	Analysis, Application	2, 4
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.	Application	2, 4
10	A room 7m x 4m x 4m is occupied by an air-water vapor mixture at 38^0C. The atmospheric pressure is 1 bar and the relative humidity is 70%. Determine the humidity ratio, dew point, mass of dry air and mass of water vapor. If the mixture of air-water vapor is further cooled at constant pressure until the temperature is 10^0C; determine the amount of water vapor condensed.	Application	2, 4
	UNIT-VII		
1	a) Define the "human comfort", and explain the factors which affect the human comfort. b) Briefly give the details of different heat loads to be considered for the evaluation of cooling load of a given room.	Knowledge , Analysis	2, 4

S. No	Question	Blooms Taxonomy Level	Course Outcome
2	ne the term "Effective temperature". Describe the factors which ffective temperature. b) With the help of a schematic diagram, explain the working of "year-round air conditioning system".	Knowledge , Comprehension	2, 4
3	a) List out different sources that contribute to the sensible heat load of the room to be air conditioned. b) Give the classification of the effects of heat on human body? Explain briefly. c) Briefly explain the thermodynamics of human body.	Knowledge , Comprehension	2, 4
4	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.	Application	2, 4
5	(a) Explain how does the body attempt to compensate for a warm environment approaching body temperature? (b) Draw and explain the comfort chart and zone of comfort for year-round air conditioning.	Comprehension, Analysis	2, 4
6	(a) Why ventilation is required? Explain why different ventilation standards for different purposes are recommended. (b) What are the important considerations in the design of an air conditioning system?	Knowledge , Analysis	2, 4
7	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.	Application	2, 4
8	a) Draw a neat diagram of winter air conditioning system and explain the working of different components in the circuit. b) Air at 10^0C DBT and 90% RH is to be brought to 35^0C DBT and 22.5^0C WBT with the help of winter air conditioner. If the humidified air comes out of the humidifier at 90% RH, draw various processes on a skeleton psychrometric chart and find out; the efficiency of the air washer	Comprehension, Application	2, 4
9	a) Differentiate between the unitary and central air conditioning syste b) 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.	Comprehension, Application	2, 4
10	a) Explain the summer air conditioning system with a neat sketch. b) Explain the procedure of construction of comfort chart.	Comprehension, Analysis	2, 4

S. No	Question	Blooms Taxonomy Level	Course Outcome
	UNIT - VIII		
1	(a) What are the sources of heat in nature which can be used for heat pumps? (b) Discuss about the performance of Heat pump when used with the different sources of heat. State the advantages and disadvantages in each case.	Knowledge , Comprehension	5
2	Describe the working of the heat pump by drawing the circuit for the following cases (a) Water to air design and (b) Air to water design	Comprehension	5
3	(a) Describe any two methods of humidification of air by atomizing the water into air, with simple line sketches. (b) With the help of a diagram, explain the Air washer humidifier and state the advantages of this type.	Comprehension	5
4	a) What are the different methods used to remove the odours from the air? b) With the help of a neat diagram, explain the functioning of dry and wet filters.	Comprehension, Evaluation	5
5	(a) Which type of air cleaner would be selected for removing very small dirt particles and smoke from the air? Explain its working principle. (b) Explain the advantages and disadvantages of viscous filters over dry filters.	Knowledge, Comprehension	5
6	(a) Explain the principle of various dehumidification methods. (b) What are the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier?	Comprehension, Knowledge	5
7	(a) Explain the process of desalination of sea water by using a heat pump with neat diagram. (b) Describe the use of heat pump for heating and cooling cycle with a neat sketch.	Comprehension	5
8	Explain the following heat pump circuits with a neat sketch i. Water –to- air design ii. Fixed refrigerant circuit design	Comprehension	5
9	Explain the following heat pump circuits with a neat sketch i. Water –to- water design ii. Air –to- liquid design	Comprehension	5
10	Describe the working of gas engine driven heat pump for heating with a neat sketch.	Comprehension	5