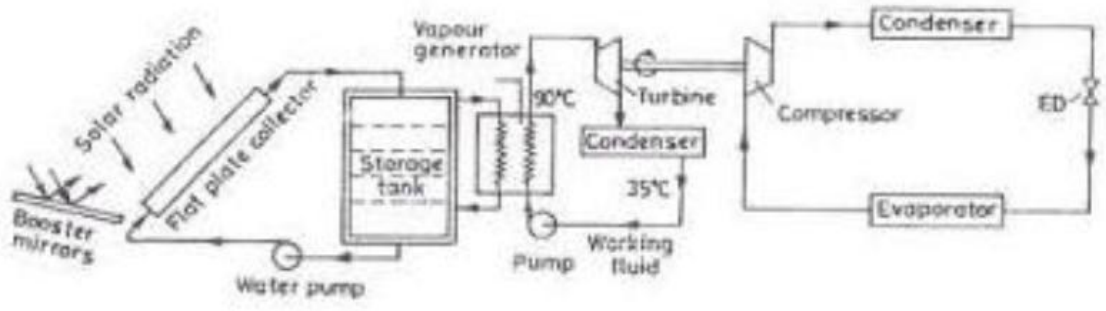
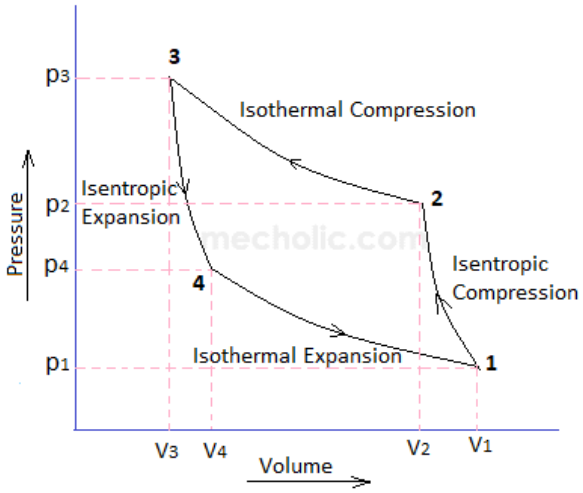
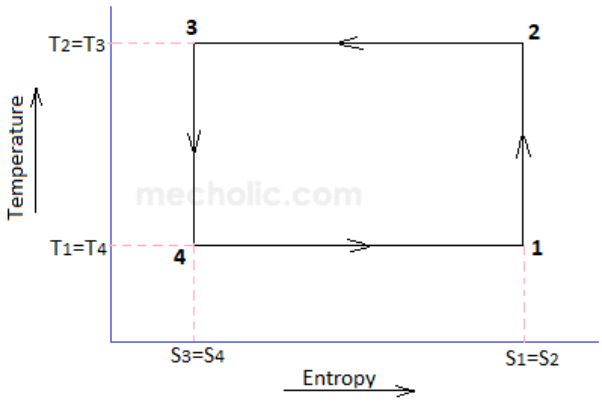
SUMMER – 19 EXAMINATION

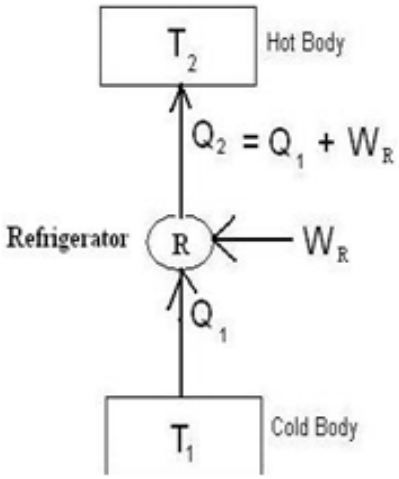
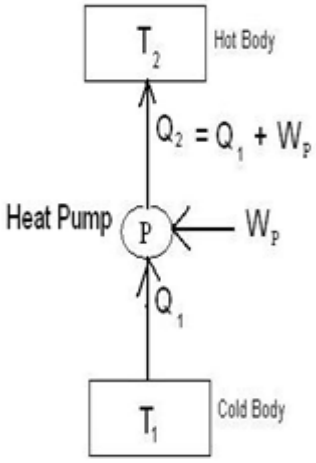
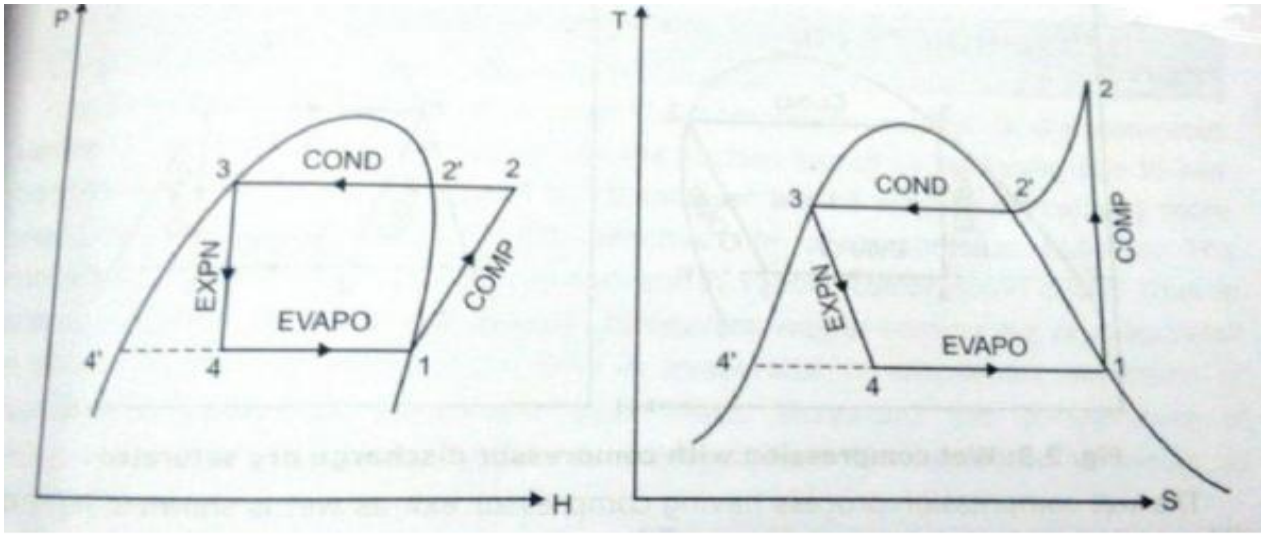
Subject Name: Refrigeration and Air conditioning Model Answer Subject Code: 17612

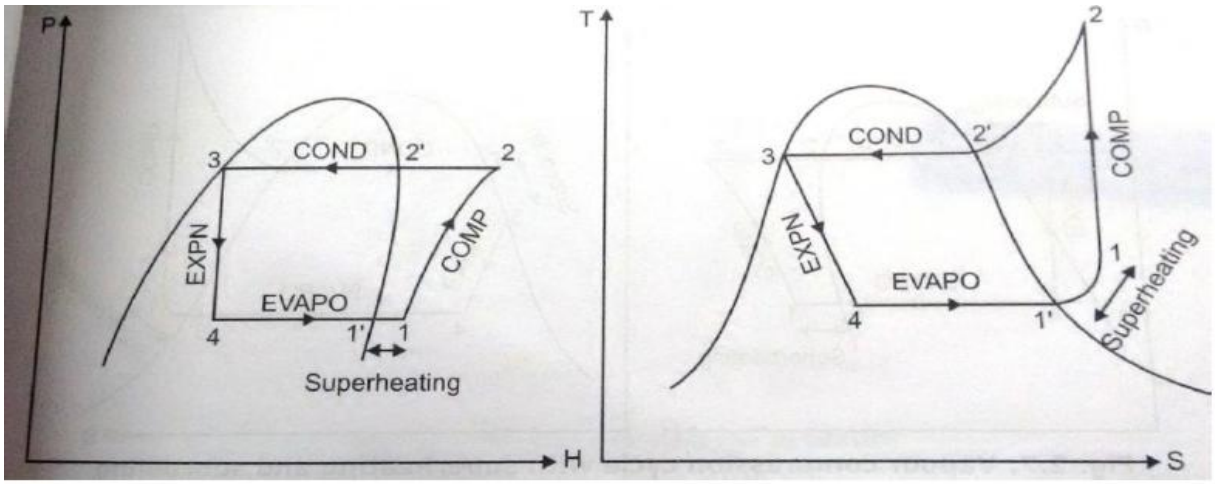
Important Instructions to examiners:

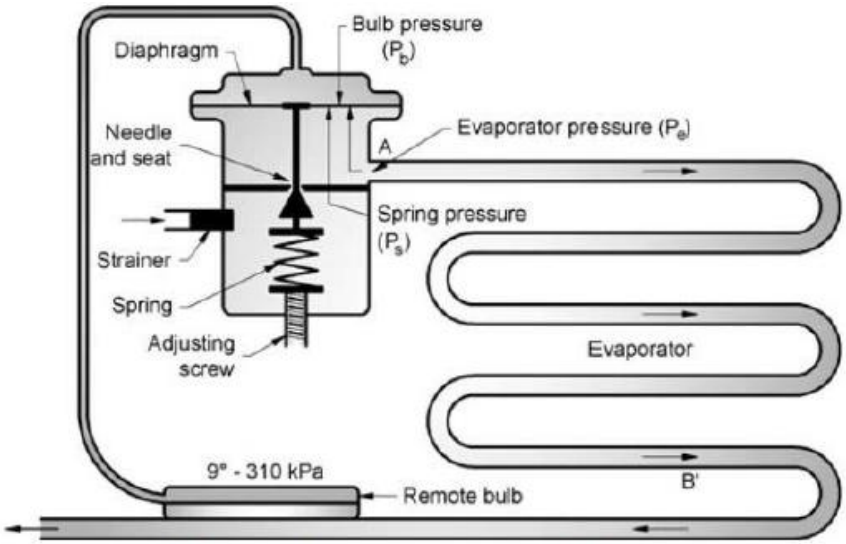
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

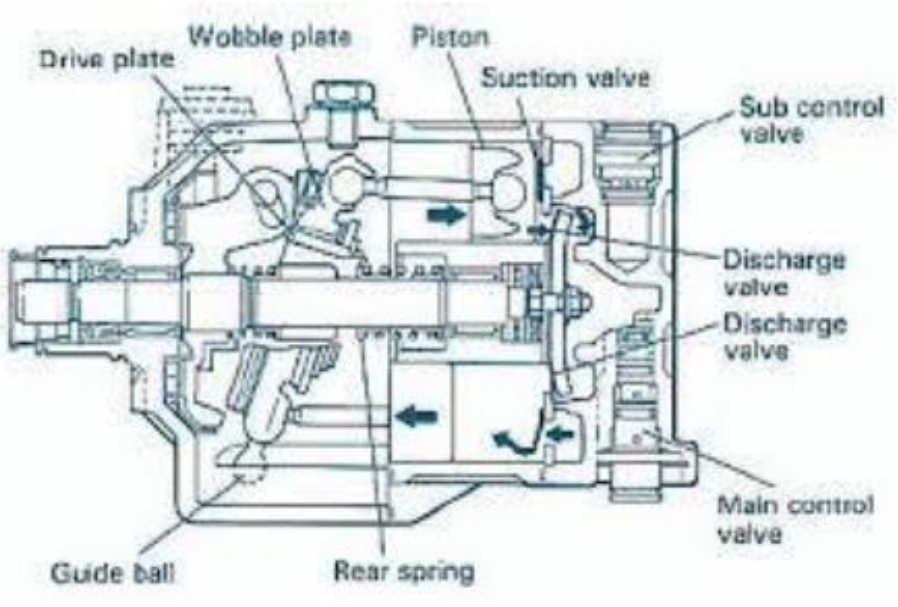
Q.1.		**Attempt any FIVE :**	**20**
a)	**i)**	**Define Ton of Refrigeration**	
	Sol.	A ton of refrigeration is defined as the quantity of heat required to be removed to from one ton of ice at 0_o C in 24 hours when initial condition of water is 0° C 1 Ton of refrigeration = 3.517 KJ/Sec or 3.517 kW	**01mark** **01 mark**
	ii)	**COP**	
	Sol.	Coefficient of Performance of refrigerator is the ratio of heat removed from sink (Refrigerating effect) by the device and work done required. COP = Refrigerating effect / Work done The value of COP is always greater than 1.	**01 mark** **01 mark**
b)		**Explain with a neat sketch Solar refrigeration system.**	
	Sol.	**(Explanation 02 Marks and Sketch 02 Marks)** A Solar vapor compression refrigeration system is shown in figure. It consists of mainly solar collector and storage tank for heat exchange in the exchanger. The turbine power is used to run the compressor of usual VAR system.It is to be noted that there is no requirement of external electrical power supply to the compressor as it is given by the turbine running on solar energy.  **Fig. Solar Refrigeration system**	**02 mark** **02 mark**

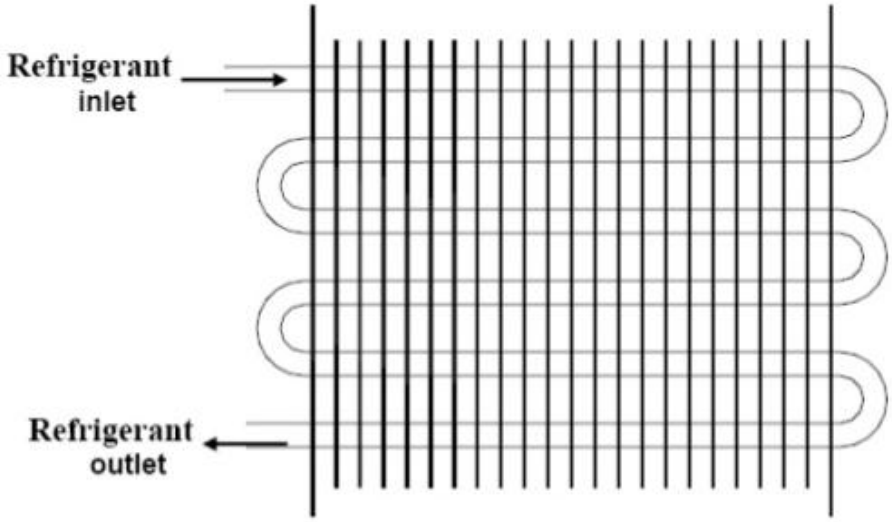
c)		**What are different secondary refrigerants? State its applications.**	
	Sol.	**Secondary Refrigerant:** 1. The refrigerants which are first cooled by primary refrigerant and then used for cooling purpose are called as secondary refrigerant. 2. Secondary refrigerants allow the amounts of environmentally harmful primary refrigerants to be minimized and contained in a restricted area. 3. Examples of secondary refrigerants include water, air, hydrocarbons, ammonia and carbon dioxide, which are more environmentally benign than traditional refrigerants such as HCFCs. They are safer and generally suitable for refrigeration systems. 4. Brines are often chosen as secondary refrigerants for large refrigeration systems, such as those supplying supermarkets, the most common brines being water-glycol solutions, water-ethanol solutions and acetate solutions. 5. It is used in ice plant and in big installation. 6. Secondary refrigerants are water, brine, glycol etc. **(Explanation 02 Marks and Applications 02 Marks)**	**04 Marks**
d)		**Draw reversed Carnot cycle on PV and TS diagram.**	
	Sol.	 **Fig(1) p-v diagram**  **Fig(2) T-s diagram** **(T-S diagram 02 Marks and P-V diagram 02 Marks)**	**04 Marks**
e)		**Compare refrigerator with heat pump with the help of a block diagram.**	
	Sol.	**Refrigerator** a) When heat transfer from low temperature (Refrigerator temp.) To high temperature (atmospheric temp) b) Particularly used for cooling purpose in a confined space. c) $COP_{ref} = Q_A / W_{net}$ d) COP of refrigerator is less than COP of Heat Pump. e) It is device which provides cooling in defined region by continuously removing the heat from low temperature body	**Heat Pump** a) When heat transfer is from low temperature (atmospheric temp.) to high temperature (roon temp.) b) Particularly used in winter to heat the rooms c) Efficiency is denoted by COP and C.O.P of heat pump is $COP_{HP} = COP_{Ref} + 1$ d) It is always greater than refrigerator by unity. e) It is device which pumps the heat to high temperature body.	**Any points 1 x4** **04 Marks**

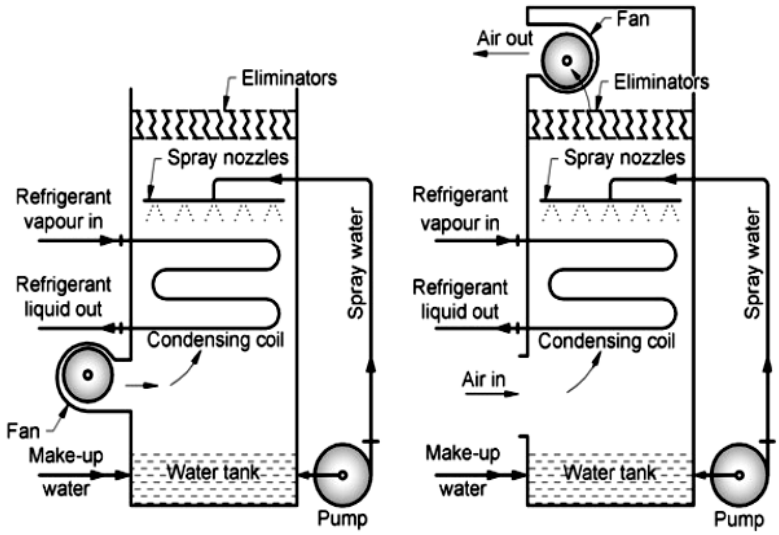
		f)Block diagram 	f) Block diagram 	
f)	**i)**	**Draw the following processes on T-S and P-h diagram.:** **Dry saturated compression**		
	Sol.	 **Fig. Vapour compression refrigeration cycle** **(T-S diagram 01 Marks and P-h diagram 01 Marks)**		**02 Marks**
	ii)	**Superheated compression**		

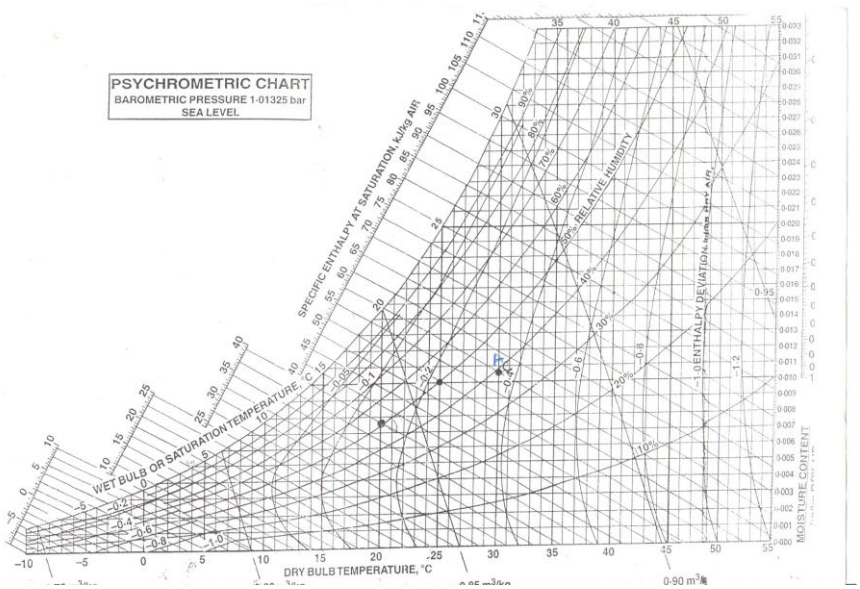
	Sol.	 **Fig. Superheating** **(T-S diagram 01 Marks and P-h diagram 01 Marks)**	**02 Marks**
g)		**Explain the concept of Ozone Depletion Potential(ODP)**	
	Sol.	Continuous Destruction of protective Ozone gas layer around earth's atmosphere by chemical reaction of CFC refrigerants which are leaked from innumerable refrigeration systems on earth's surface is known as "Ozone Layer Depletion". In Stratosphere layer there is more concentration of Ozone gas. This ozone layer forms a protective layer around earth's surface which absorbs the Harmful Ultraviolet rays (UV) from Sun's rays and allows only beneficial light and heat rays to reach on earth's surface. Prevention of UV rays reaching to earth's surface protects human and Depletion of Ozone layer leads to formation of "Ozone Holes" in the Ozone layer and through these ozone holes Harmful Ultra Violet rays enters into the atmosphere endangering the earth's biolife. Ozone depletion potentials (ODPs) were a very important measure in the formulation of the Montreal Protocol and its Amendments. ODP values are used to provide a simple way to compare the relative ability of various ODS to destroy stratospheric ozone. ODP is defined as "the integrated change in total ozone per unit mass emission of a specific ozone-depleting substance relative to the integrated change in total ozone per. Harmful effects of UV rays on people: Skin cancer ,Premature aging of the skin Cataracts and eye disorders ,Immune system damage.	**04 Marks**
2.		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	**Explain construction and working of Thermostatic expansion valve with a neat sketch.**	
	Sol.	**Thermostatic expansion valve** : The operation of this valve is based on the principle of constant degree of superheat for the vapor at or exists i.e. by controlling the flow of liquid refrigerant through the evaporator. The thermostatic expansion valve consists of a needle valve and a seat, a metallic diaphragm, spring and adjusting screw. In addition to this it has a feeder or thermal bulb which is mounted on the suction line of compressor near the outlet of the evaporator coil. The filler bulb is partly filled with the same liquid refrigerant as used in refrigeration system. The opening or closing of valve is depended upon the force on the diagram. **Operation :** The remote bulb is charged with fluid which is open on one side of the diaphragm through capillary tube is firmly to evaporate outlet. The pressure (Pb) of the fluid in the bulb tends to open	

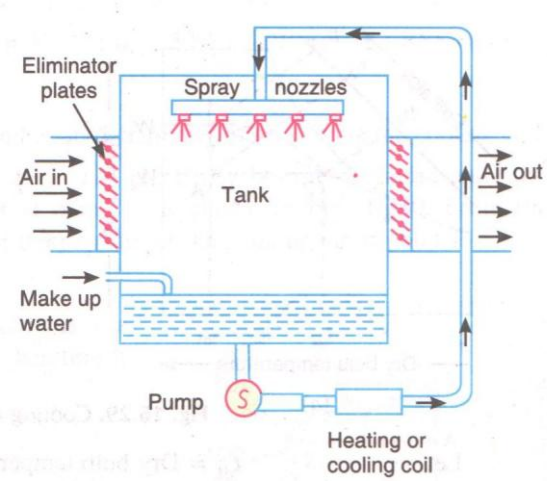
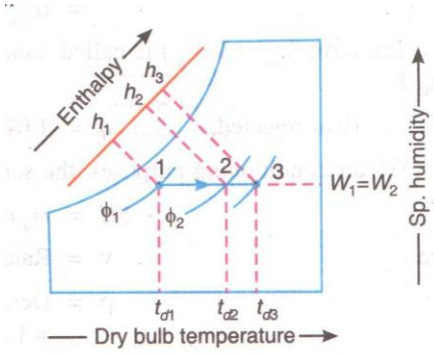
		the valve. This pressure is balanced by pressure due to spring (PS) and in the evaporator (Pe). If the evaporator temperature is high or the load on the evaporator increase, more fluid from feeler bulb will be vapourised and bulb pressure will rises which exert this force on diaphragm. This will widen the valve opening and the refrigerant flow will increase to meet load demand and if load on evaporator decreases reverse action takes place. **Sketch:**  Fig. Thermostatic expansion valve **(Construction 01Mark, Working 01 Mark & Diagram 02 Marks)**	**04 Marks**
	b)	**Explain in brief Global warming potential(GWP).**	
	Sol.	Global Warming is an increase in earth temperature. It has been changing at a much faster rate than normal due to accelerated generation of green house gasses due to industrialization. It is a threat to human being, general upward trend of the earth temperature will drastically changes accessibility to food, water, row material and energy sources for animals and humans alive. Global warning has increased ocean level, leakage of CFC also help in depletion of ozone layer, which causes to allow the infrared radiation directly on earth. The trapping of this infrared temperature. All greenhouse gases have what is called a Global Warming Potential (GWP). This value is used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the heat-absorbing ability of each gas relative to that of carbon dioxide (CO2), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years). GWPs can also be used to define the impact greenhouse gases will have on global warming over different time periods or time horizons. These are usually 20 years, 100 years and 500 years. For most greenhouse gases, the GWP declines as the time horizon increases. This is because the greenhouse gas is gradually removed from the atmosphere through natural removal mechanisms, and its influence on the greenhouse effect declines. Some of the CFCs however, have long atmospheric lifetimes, and the 100-year GWP may be greater than the 20 year GWP.	**Explanation 04 Marks**
	c)	**Explain in brief compressor used in car air conditioning system.**	
	Sol.	The pistons in an opposed axial compressor are connected together by a solid piece that keeps them at a fixed distance from each other. A rotating device called the swash plate causes the	

		pistons to move. The swash plate is an elliptical disc that is mounted at an angle to the compressor drive shaft.  	**02 Marks Explanation** **02 Marks Sketch**
	d)	**What are the applications of Hermetic, Centrifugal, Plate type and Scroll type compressors?**	
	Sol.	• **Hermetic Compressors:** Domestic refrigerator, window air conditioning. Split window air conditioning. Hermetically sealed reciprocating compressor is widely used for the refrigeration and air conditioning applications. In all the household refrigerators, deep freezers, window air conditioners, split air conditioners, most of the packaged air conditioners, the hermetically sealed reciprocating compressor is used. Used in residential and light commercial applications. • **Centrifugal Compressors:** Used extensively for air conditioning in large structures. Becoming more popular for their ability to handle liquid refrigerant without compressor damage Centrifugal compressors • **Plate type Compressors:** A swash-plate type compressor for air conditioning of vehicles. • **Scroll type Compressors:** primarily in domestic refrigerators Scroll compressor. Manufactured in a variety of sizes up to 25 tons and found into a variety of refrigeration and HVAC applications. It have been successfully used for bulk milk cooling, truck transportation, marine containers and grocery display cases. Heavy commercial HVAC applications in unitary (rooftop) systems, heat pumps, water chillers for process and building cooling, large split system condensing units and also used in transportation industry.	**01 Mark** **01 Mark** **01 Mark** **01 Mark**
	e)	**Explain the working of finned evaporator with a neat sketch.**	
	Sol.	The finned evaporators are the bare tube type of evaporators covered with the fins. When the fluid (air or water) to be chilled flows over the bare tube evaporator lots of cooling effect from the refrigerant goes wasted since there is less surface for the transfer of heat from the fluid to the refrigerant. The fluid tends to move between the open spaces of the tubing and does not come in contact with the surface of the coil, thus the bare tube evaporators are less effective. The fins on the external surface of the bare tube evaporators increases the contact surface of the of the metallic tubing with the fluid and increase the heat transfer rate, thus the finned evaporators are	

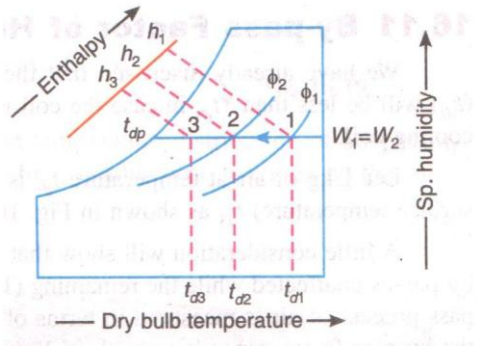
		more effective than the bare tube evaporators. The fins are the external protrusions from the surface of the coil and they extend into the open space. For the fins to be effective it is very important that there is very good contact between the coil and the fins. In some cases the fins are soldered directly to the surface of the coil and in other cases the fins are just slipped over the surface of the fins and then they are expanded thus ensuring a close thermal contact between the two. Tough the fins help increase the heat transfer, rate, adding them beyond certain numbers won't produce any additional benefits, hence only certain number of fins should be applied on the external surface of the tube. The finned evaporators are most commonly used in the air conditioners of almost all types like window, split, packaged and the central air conditioning systems.  Fig. finned evaporators **(Explanation 02 Marks and sketch 02)**	**04 Marks**
	f)	**What are the sources which contribute to the sensible heat gain ?**	
	Sol.	**Sensible heat gain: (Any Four Points)** When there is a direct addition of heat to the enclosed space, a gain in the sensible heat is said to occur. This sensible heat is to be removed during the process of summer air conditioning. The sensible heat gain may occur due to any one or all of the following sources of heat transfer: (a) The heat flowing into the building by conduction through exterior walls, floors, ceilings, doors and windows due to the temperature difference on their two sides. (b) The heat received from solar radiation. It consists of (i) The heat transmitted directly through glass of windows, ventilators or doors (ii) The heat absorbed by walls and roofs exposed to solar radiation and later on transferred to the room by conduction. (c) The heat conducted through interior partition from rooms in the same building which are not conditioned. (d) The heat given off by lights, motors, machinery, cooking operations, industrial processes etc. (e) The heat liberated by the occupants. (f) The heat carried by the outside air which leaks in (infiltrating air) through the cracks in doors, windows, and through their frequent openings.	**04 Marks**

		(g) The heat gain through the walls of ducts carrying conditioned air through unconditioned space in the building (h) The heat gain from the fan work.	
Q.3		**Attempt any FOUR of the following:**	**16 Marks**
a)	**a**	**Explain in brief evaporative condensers with a neat sketch** Principle of evaporative condenser: (draw any one sketch of the following)  **(a) Forced circulation** **(b) Induced circulation** The evaporative condenser perform both the combined function of a water cooled condenser and a cooling tower. In its operation the water is pumped from sump to spray header and sprayed through nozzles over the condenser coil through which hot refrigerant from compressor is passing. Heat is transferred from refrigerant in the condenser into the water that is outside the surface of tuber. A fan is also used which draws air from the bottom side of condenser and discharges out at the top of condenser. The air causes the water from the surface of the condenser coils to evaporate and absorb the latent heat of evaporation from the remaining water to cool it. Since heat for vaporizing the water is taken from the refrigerant, therefore the vapour refrigerant condenses into liquid refrigerant. The cold water that drops down into a sump is recalculated. A float valve keeps a check of water level. The eliminator is provided above the spray header to stop particles of water escaping along with the discharge air	**. (Sketch 2 Marks and Explanation 2 Marks)**
	b	**Define** **1.** Specific Humidity: Specific humidity is defined as the proportion of the mass of water vapor and mass of the moist air sample (including both dry air and the water vapor); it is closely related to humidity ratio and always lower in value. 2. Dry Bulb Temperature: The temperature of the air measured by the ordinary	**02**

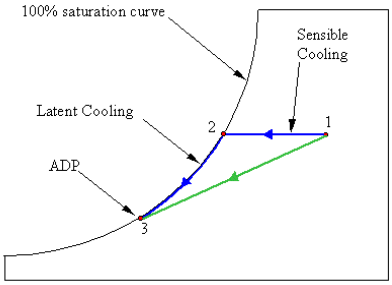
		thermometer is called as the dry bulb temperature of air, commonly referred as DBT. When ordinary thermometer is exposed to the atmosphere, it indicates the dry bulb temperature, which is nothing but the atmospheric temperature.	**02**
	c	**What is Daltons law of partial pressure?** Dalton's partial pressure law : It states that total pressure of mixture of gases equal to the sum of partial pressures exerted by each gas when it occupies the mixture volume at the temperature of mixture . If P_T – Total pressure of the mixture Pa – Partial pressure of gas 'a' P_b - partial pressure of gas 'b' According to Dalton's partial pressure law, we have , $P_T = Pa + P_b$	**02** **02**
	d.	**The DBT and WBT of air is at 30 ^{o} C and 20 ^{o} C respectively. Find the following from the psychrometric chart** **(i) Relative humidity** **(ii) Enthalpy** **(iii)Moisture content** **(iv)Dew point** **As shown on the psychrometric chart point A , following are the values,**  **(v) Relative humidity = 40%**	**1mark each**

		(vi)Enthalpy =62.5kJ/kg of air **(vii) Moisture content = 0.0109 kg / kg of dry air** **(viii) Dew point = 14.5 ^{0} C**	
	e	**Explain any humidifier with a neat sketch** The humidification is achieved either by supplying or spraying steam or hot water or cold water into the air. Air washer is the indirect method of humidification. In this method water is introduced into the air in the airconditioning plant, with the help of an air washer as shown in the figure. This conditioned air is then supplied to the room to be air conditioned.  	**02** **02**
	f	Show the following pshchrometric properties on chart (i) Sensible heating (ii) Sensible cooling (iii)Cooling and dehumidification (iv)Heating and humidification Sensible heating  	**01 mark** **01 mark**

Sensible cooling

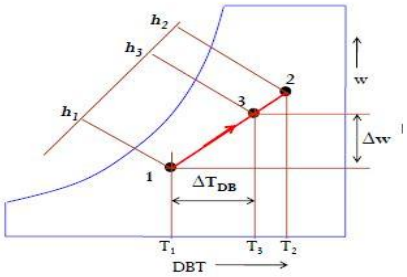


Cooling and dehumidification



PSYCHROMETRIC CHART SHOWING COOLING AND DEHUMIDIFICATION

Heating and humidification



4		**Attempt any TWO of the following:**	**12**
	a	**In a simple VCC following are the properties of R-134a at various points**	**08**

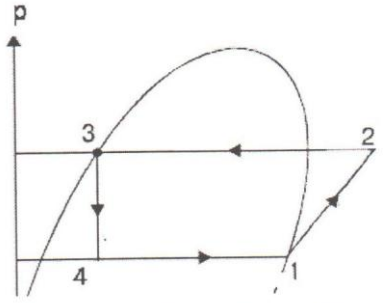
Location of refrigerants	Enthalpy (KJ/kg)	Specific volume (m^3/kg)
Compressor inlet	$h_1 = 183.2$	$V_1 = 0.0767$
Compressor discharge	$h_2 = 222.6$	$V_2 = 0.0767$
Condenser exit	$h_3 = 84.9$	$V_3 = 0.0767$

The piston displacement volume for the compressor is 1.5 litre per stroke and it volumetric efficiency is 80 % . speed of the compressor is 1600 rpm. Find

(i) Compressor power in kW

(ii) Refrigeration capacity in tons of refrigeration (TR)

Given



P – h diagram of VCR cycle

Volume of refrigerant V = 1.5 lit/stroke

Volumetric efficiency η = 0.80%

Speed N = 1600 rpm

h1 = 222 kJ/kg, h2 = 183 kJ/kg, h4 = 84 kJ/kg

COP of cycle if given by COP = = (183.2 – 84.9) / (222.6-183.2) = 2.49

Volume of refrigerant admitted in per min

= 1.5 x 1600 x 0.80 = 1920 lit/min = 1.9 m^3/min

Mass of refrigerant = m = 1.9 / v2 = 1.9 / 0.0767 = 25.03 kg/min

Refrigeration capacity = m (h1 – h4) = (25.03 x (183.2-84.9)) /211

=11.66TR

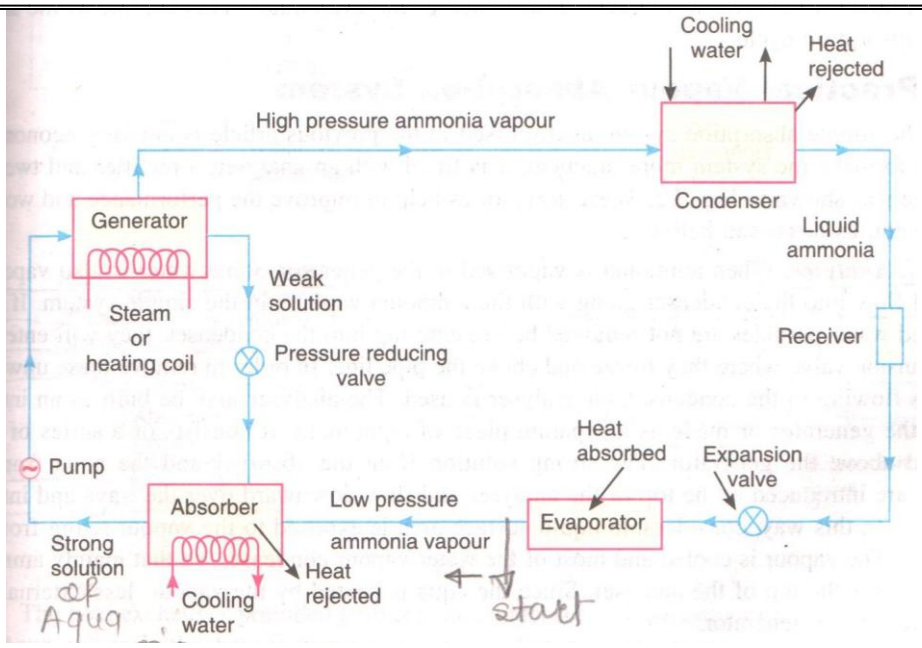
Power of compressor WC = m (h2 – h1) = (25.03/60)* (222.6-183.2) = 16.43kW

	b	**Estimate cooling load calculation for CAD/CAM laboratory of your institute**	**08**

Heat Load for CAD/CAM Lab (04 Heat sources with explanation: 02 marks each)

CAD/CAM lab has mainly number of computers in it .

		Other heat load coming is as follows a) Conduction: due to sunlight, the wall gets heated in day hours. Due to hot walls heat is received from outside b) Radiation: as the lab is packed with glass windows and curtains, the amount of heat infiltrated is not much more some heat may leak in from window /door frame gaps. c) Occupants load:- The occupants are staff, students in batches .so the heat load coming on lab during practical hours is more. d) Equipments: the main equipments in lab are tubes, A/c equipments, bulbs etc. The lab dimensions are about 18^I x 30^I. To have complete maintenance of temperature about 20 ^oC, RH about 60 % with apparatus bypass factor of 0.15, Requirement; 4 split air conditioners of 1.5 capacity each is suggested. (This is for particular Institute. Answer may differ)	
	c	Explain working of Aqua ammonia vapour absorption refrigeration system with a neat block diagram The simple vapour absorption system is shown in figure. It consists of an absorber, a pump, a generator and a pressure reducing valve to replace the compressor of VCR system . In this system, the low pressure ammonia vapour leaving the evaporator enters the absorber where it is absorbed by the cold water in the absorber. The water has the ability to absorb very large quantities of ammonia vapour and the solution thus formed is known as aqua- ammonia. Some form of cooling arrangement is employed in the absorber to remove the heat of solution evolved there. . The strong solution thus formed in the absorber is pumped to the generator by the liquid pump. The strong solution in the generator is heated by some external source such as gas or steam. During heating, the ammonia vapour is driven off the solution at high pressure leaving behind the hot weak ammonia solution in the generator which flows back to absorber after the reducing valve. The high pressure ammonia vapour from generator is condensed in the condenser to a high pressure liquid ammonia. This liquid ammonia is pass3ed through the expansion valve and then to the evaporator completing the cycle.	04marks 04



Q. No.	Sub Q. N.	Answer	Marking Scheme
5		Attempt any TWO of the following :	16 Marks
	(a)	What are the desirable properties of a refrigerant? 1.Thermodynamic Properties: (a) Boiling Temperature: Boiling temperature of the refrigerant should be low to reduce the capacity of compressor. (b) Freezing Temperature: The freezing temperature should be below the evaporative temperature to prevent the refrigerant from freezing during operation. (c) Evaporator and Condenser pressure: Both Evaporator and Condenser pressure should be above slightly above the atmospheric level. Positive pressure required to prevent leakage of air and moisture in to the refrigerant system. (d) Compression ratio: It should be as small as possible. 2. Chemical Properties: Refrigerant should be non-toxic and non-flammable. Refrigerant should be non-corrosive and it should be chemically stable. 3. Physical properties: It should have low viscosity and high thermal conductivity. Refrigerant should easily available and it should be economical.	08 Marks (Thermodynamic properties 04 marks + Chemical and physical properties 02 marks each)
	(b)	Explain with neat sketch of Electrolux refrigerator. Ans: It is old system known as three fluid absorption system in which refrigerant is ammonia and solution used is aqua ammonia. Third liquid is hydrogen gas. 1. Circulation of system is achieved by providing high pressure in condenser and generator and low pressure in evaporator and absorber. 2. Liquid ammonia flows under gravity into evaporator. As soon as ammonia liquid enters evaporator partial pressure of ammonia decreases due to presence of	08 Marks (04 Marks for Fig and 04 Marks for explanation)

hydrogen.

3. Mixture of ammonia vapour and hydrogen vapour passed to the absorber. Weak solution of aqua ammonia is sprayed into absorber where it absorbs ammonia vapour and converted into strong solution. Hydrogen left is recirculated in evaporator. Then strong solution passed through heat exchanger where heat is transfer from weak aqua ammonia to strong aqua ammonia solution.
4. Strong aqua ammonia solution heated in generator and due to addition of heat ammonia vapour are release and strong solution converted into weak solution, which is passed to the absorber.
5. Then moisture in ammonia removed by analyzer and rectifier.
6. Advantage of this system is it has no moving parts, no noise and can be used where no electricity is available.

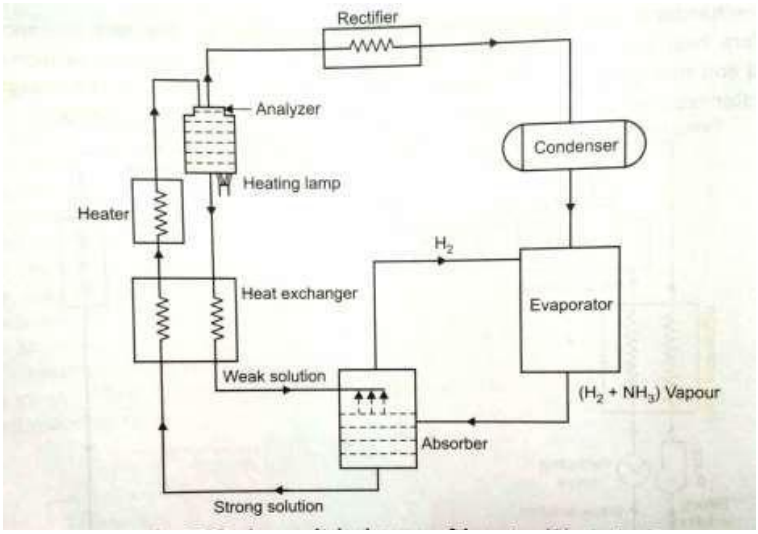


Figure: Electrolux Refrigeration system.

(c) What are the desirable properties of an insulating material? — 08 Marks

Answer: A) Thermal properties: 1. Low thermal conductivity: Thermal conductivity of insulating material should be as low as possible to reduce the thickness of material.
2. High permanence: Materials may disintegrate as a result of internal chemical activity. Resistance to above activity is permanence. It should be high
B) Mechanical Properties: 1. It should have high strength in compression tension shear and impact as it is carrying some loads
2. It should be light weight.
C) Physical properties: 1. It should be odourless.
2. It should be fire proof.
3) It should be chemically inert.
D) Availability and Hygiene.
1. It should be easily available and at low cost.

(02 Marks for each point)

		2. Resistance to fungus and vermin.	
6			
	(a)	Attempt any FOUR	
		Classify air conditioning system. Answer: Air conditioning system broadly classified as follows 1.According to purpose: a. Comfort Air conditioning System b. Industrial Air conditioning System. 2.According to the season of the year: a. Winter air conditioning system b. Summer Air conditioning system c. All weather Air Conditioning system. 3.Classification according to equipment arrangement : a. Central Air Conditioning b. Unitary Air Conditioning 4.According to Working substance used in the system: a. All Air system. b. Chilled water system c. Air water system	16 Marks 04 Marks (01 Mark each)
	(b)	What is the different types of fans? Types:- 1. Centrifugal fan: i) Forward blade Centrifugal fan ii) Radial blade Centrifugal fan iii) Backward blade Centrifugal fan 2. Axial flow fan: i) Propeller fan ii) Tube axial fan 3. Vane axial fan.	04 Marks
	(c)	Explain with a neat sketch of domestic refrigerator.	

Answer :

Domestic refrigerator consist of four basic components: (i) Evaporator; (ii) Condenser;(iii) Compressor ;(iv) Expansion device.

The evaporator is located in the freezer compartment of the refrigerator. It forms the coldest part of the cabinet, while the refrigerant evaporates inside the evaporator tubes. Just below the freezer, there is a chiller tray. Further below are compartment with progressively higher temperatures.

The design of condenser is usually wire and tube or plate type mounted at the back of the refrigerator. The refrigerant vapor is condensed with the help of natural air. Mostly hermetically sealed compressor used in domestic refrigerator.

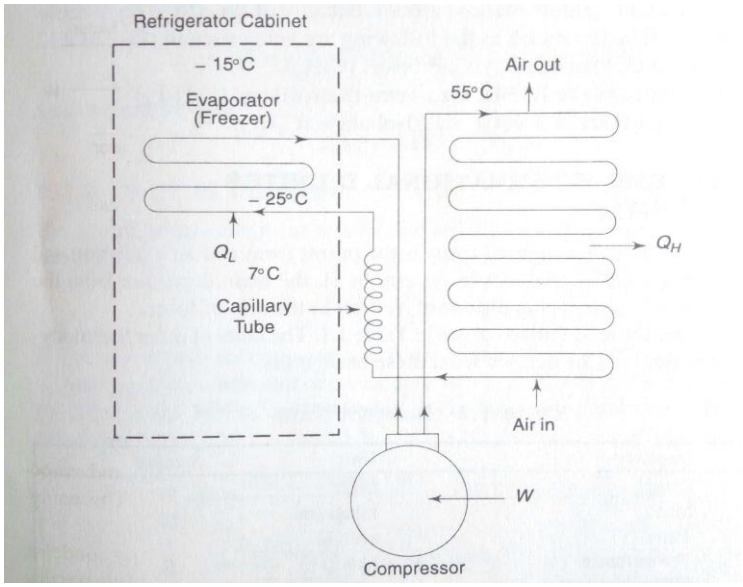


Figure: Schematic diagram of a Domestic refrigerator.

04 Marks (02 marks for figure and 02 for explanation)

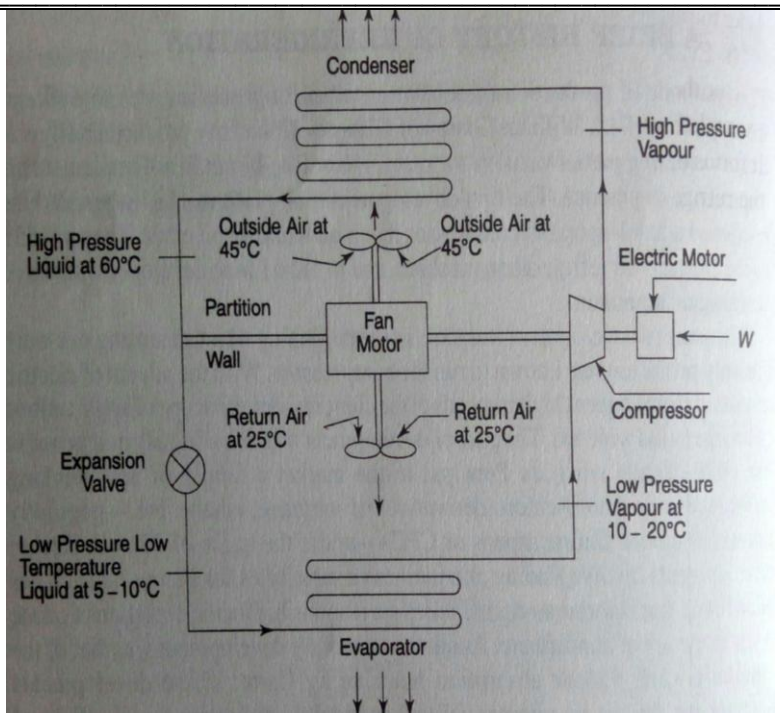
(d) Explain with a neat sketch of a room air conditioner.

Answer: Room air conditioner consist of a casing which is divided into two parts by a vertical partition i.e. outdoor part and indoor part.

The indoor part fitted in to the room which consists of evaporator, motor driven fan, expansion device and control planet, an air filter, power connection and tray.

Condenser is connected to evaporator by capillary tube through filter. Evaporator is connected to compressor by suction pipe line and compressor is connected to condenser by discharge pipe line.

04 Marks (02 marks for figure and 02 for explanation)

	(e)	 Figure : Room Air Conditioner.	04 marks
	(f)	Explain in brief central Air conditioning system. Answer: In central air conditioning system all the components are group together in one central room and conditioned air then distributed from central room to the required places through the extension duct system. The main components of central system are compressor with motor drive, condenser with cooling coil, throttling devices. This system used large capacity units. (above 25 tons). The central air conditioning either direct or indirect type. Direct Expansion: air from the space to be conditioned is circulated over the cooling coil (liquid refrigerant) of the refrigeration plant. So called Direct Expansion type system. Indirect Expansion System: Chilled water or brine is circulated through the cooling coil to cool and humidify the room air. It can be located away from the air conditioned place. Noise and vibration problems are eliminated. The commercial applications of air conditioning system. 1.Laboratories: to make precise measurements 2. Printing : to control temperature and humidity 3.Textile manufacture :greatly depends on moisture control 4.Pharmaceutical: industry needs refrigeration to reduce air borne bacteria and dirt to preserve products 5.Photographic: products deteriorate rapidly at high temperatures and high humidity 6. Manufacture of Precision Parts: 7. Farm Animals 8. Computer Rooms:	04 Marks (Each points ½ marks)
