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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2538 Roll No. | | | | | | | | | |

B. Tech.

(SEM. VI) THEORY EXAMINATION 2010-11

REFRIGERATION AND AIR CONDITIONING

Time : 3 Hours *Total Marks : 100*

Note : Attempt all the questions. All questions carry equal marks. Assume any missing data suitably. Steam tables, Psychromatic charts and Refrigeration tables may be provided.

1. Attempt any four parts of the following : (5×4=20)

   (a) What is the importance of refrigeration and what are the different methods of producing refrigeration ? Also define COP and unit of refrigeration.

   (b) Practically Carnot COP is impossible to achieve in practice, then why we study the same ?

   (c) What is the basic different between open and closed air refrigeration cycles ? Describe a Bell Coleman or reversed Joule air refrigeration cycle with the help of a neat sketch.

   (d) Explain the difference between throttling and isentropic

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expansion. Although some work can be extracted from isentropic expansion process after the refrigerant leaves the condenser an irreversible process is generally preferred. Explain the reasons.

(e) The COP of an air refrigeration cycle is very low, even then why air refrigeration system is most common in aircrafts ?

(f) A cold storage plant is required to store 20 tons of fish. The temperature of fish when supplied was 27°C, storage temperature of fish required = –9°C, specific heat of fish above freezing point = 2.95 kJ/kg -°C, specific heat of fish below freezing point = 1.25 kJ/kg-°C, freezing point of ice = –3°C, latent heat of fish = 230 kJ/kg. If the cooling is achieved within 10 hours find the capacity of refrigeration plant.

2. Attempt any two parts of the following : **(10×2=20)**

(a) (i) What are the main characteristics of a vapour compression refrigeration system and what are its advantages over air refrigeration system ?

(ii) What do you understand by multistage compression and why it is required in a system when the difference between the evaporator and condenser pressures is large ?

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(b) A vapour compression machine is used to maintain –23°C in a refrigerated space. The ambient temperature is 37°C. The compressor takes in dry saturated vapour of R12. A minimum 10°C temperature difference is required at the evaporator as well as at condenser. There is no sub cooling of liquid. If the refrigerant flow rate is 1 kg/min, find

(i) tonne of refrigeration

(ii) power required and

(iii) ratio of COP of this cycle to COP of Carnot cycle.

(c) A two stage vapour compression refrigeration system working on R12 refrigerant is operating between pressure limits of 1 bar and 10 bar. The refrigerant leaves the condenser as saturated liquid and is throttled to a flash chamber operating at 3.2 bar. Vapour from flash chamber is mixed to the refrigerant leaving the LP compressor. The mixture is then compressed to condenser pressure by HP compressor. The liquid in the flash chamber is throttled to the evaporator. Assuming refrigerant leaves the evaporator as a saturated vapour and both compression being isentropic, calculate

(i) mass fraction of vapour leaving flash chamber

(ii) refrigerant effect per kg of refrigerant and

(iii) COP of system.

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3. Attempt any two parts of the following : (10×2=20)

(a) What is the basic difference between a vapour absorption refrigeration system and a vapour compression refrigeration system ? Explain how the function of the compressor in a vapour compression refrigeration system is achieved in vapour absorption refrigeration system and by which components.

A steam of 15 kg/s of aqua-ammonia ($c_1 = 0.8$) at 0°C and 5 bar mixes adiabatically with another saturated liquid stream with flow rate 10 kg/s and 100°C at the same pressure. Establish the state point on h-c diagram and obtain

(i) mixture concentration

(ii) mixture enthalpy

(iii) amount of liquid and vapour after mixing.

(b) (i) With the help of a neat sketch, describe the working principle of a lithium bromide water absorption refrigeration system in brief and also compare it with the ammonia-water vapour absorption refrigeration system.

(ii) Enlist the desirable properties of refrigerant. Name some common refrigerant generally used in refrigeration system.

(c) (i) Show the throttling process on enthalpy concentration (h-c) diagram.

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(ii) What do you understand by maximum COP of a vapour absorption refrigeration system and how do you calculate its value in terms of evaporator, generator, condenser and absorber temperatures ? In a vapour absorption refrigeration system, the generator is operated by solar heat where the temperature achieved is 100°C. If the evaporator temperature is −10°C and the condenser/absorber temperature are 35°C, what is the maximum possible COP of the system ?

4. Attempt any two parts of the following: (10×2=20)

(a) What is air-conditioning and what is basic difference refrigeration and air-conditioning ? The DBT and WBT of atmosphere air are 35°C and 23°C respectively when the barometer read 1.01325 bar. Determine (without making use of psychrometric chart and using the Carrier equation) (i) relative humidity, (ii) humidity ratio, (iii) dew point temperature, (iv) enthalpy of atmospheric air and (v) degree of saturation.

(b) Explain the physical significance of room sensible heat factor (RSHF).

An air conditioned auditorium is to be maintained at 27°C DBT and 60% RH. The ambient condition is 40°C DBT and 30°C WBT. The total sensible heat load is 100,000 kJ/h and the total latent heat load is 40,000 kJ/h. 60% of the

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return air is recirculated and mixed with 40% of the makeup air after the cooling coil. The condition of air leaving the coil is 18°C. Determine

(i) room sensible heat factor

(ii) the condition of air entering the auditorium

(iii) the amount of makeup air

(iv) apparatus dew point and

(v) bypass factor of cooling coil.

Show the process of psychromatic chart.

(c) (i) Explain the brief, the concept of heating and cooling loads. What are different factors considered in load estimation for comfort air-conditioning ?

(ii) Explain in brief, the concept of thermal analysis of human body, being used for comfort air-conditioning. Also give the concept of effective temperature and comfort chart, in brief.

5. Attempt any two parts of the following : (10×2=20)

(a) Enlist various refrigeration equipments used in a vapour compression refrigeration system. What are the different types of compressors generally used in refrigeration and air conditioning units ? What do you understand by hermetically sealed compressors and what are its main advantages over ordinary coupled units ?

(b) (i) What is food preservation ? Enumerate some common methods being used for food preservation, in brief.

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(ii) Describe a cold storage in brief. What is the importance of storage period and preservation conditions in the design of a cold storage ?

(c) (i) Describe the working of cooling towers with the help of neat sketches.

(ii) With the help of example, explain in brief, any one of the following method of duct design :

(a) equal friction loss (pressure drop) method

(b) static regain method.

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