KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 4th year 1st Term Examination, 2017
ME 4017 (Backlog)
(Refrigeration and Air-conditioning)

Time: 3 Hours. Total Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Necessary Charts may be supplied on request.
iv) Assume reasonable data if any missing.

SECTION - A

1(a)	What is refrigeration? What are its applications?	05
1(b)	Draw the thermodynamic cycle in p-v, T-s and p-h planes for both ideal and actual cases.	12
1(c)	Why sub-cooling of liquid from condenser and super heating of gases from evaporator are needed in a refrigeration cycle?	04
1(d)	A refrigeration plant produces 10 Ton of cooling effect using R-22 as refrigerant. The condenser temperature is 40°C and evaporator temperature is -10°C. Considering that it follows an ideal cycle, calculate – (i) mass and volume flow rate; (ii) compressor power, and (iii) COP.	14
2(a)	What benefits a multi-evaporators and multi-compressors refrigeration systems do enjoy?	08
2(b)	Describe the working principle of a reciprocating compressor.	10
2(c)	Why an aircraft is needed to cool? Describe Boot-strap system of aircraft cooling.	11
2(d)	What are the advantages and disadvantages of steam jet refrigeration?	06
3(a)	What is refrigerant? Discuss the desirable characteristics of a fluid to be used as a refrigerant.	07
3(b)	Describe the Claude system for liquefaction of air with schematic diagram.	10
3(c)	What are the basic differences between vapour absorption and vapour compression system? Describe the vapour absorption system with schematic diagram.	14
3(d)	What is secondary refrigerant?	04
4(a)	What is dry ice? What are the advantages of using it?	06
4(b)	Describe vortex tube refrigeration system with neat sketch. What are its applications?	09
4(c)	A dry ice manufacturing plant produces 200 kg/hr of dry ice. The high side and low side pressures are 12 bar and 3 bar respectively and ambient CO_2 enters the system at 30°C. Considering a standard cycle, calculate power required for the compressor.	20

SECTION – B

5(a)	What is air conditioning? Present the classification of air conditioning system.	06
5(b)	What are the basic thermodynamic process needed for air condition design calculation?	04

5(c) What are sensible and latent heat of air? How are they calculated in designing air conditioning? 11

5(d) Moist air enters a chamber at the conditions 38°C DBT and 25°C WBT at the rate of 70 cmm. The barometric pressure is 1.0132 bar. While passing through the chamber, the air losses sensible heat at the rate of 40 kW and also moisture at the rate of 30 kg/hr. Determine the dry bulb and wet bulb temperatures of leaving air. 14

6(a) Describe the summer air conditioning system with neat sketch. 08

6(b) What is ventilation? Why is it required in an air conditioning system? 06

6(c) What is infiltration? In how many ways infiltration may occur in a conditioned space? 06

6(d) A building has the following cooling loads: 15

Room sensible heat = 15 kW; Room latent heat = 10 kW; Inside design conditions: 24°C DBT and 50% RH; Bypass factor = 0.15; Return air from conditioned space is mixed with outdoor air before entering the cooling coil in the ratio of 5:1 by weight. Determine-

(i) Apparatus dew point;
(ii) Conditions of the air leaving the cooling coil;
(iii) Dehumidified air quality;
(iv) Total refrigeration load on the system.

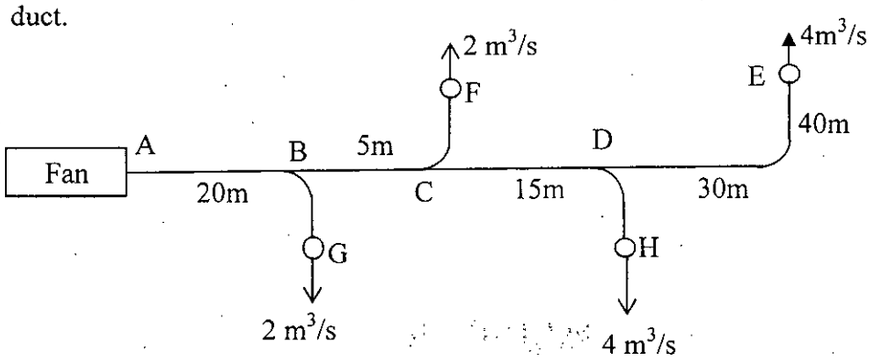
7(a) What is cooling load? What are the components to be considered in calculating the cooling load? 10

7(b) A banking building is to be designed for 100 persons. The size of the building is 20×16×5 m high, outside condition (32°C DBT and 27°C WBT), inside condition (23°C DBT and 50% RH), tube light (20×20 W each), one refrigerator of 300 W, other electrical appliances of 2 kW, energy release from persons: latent heat 600 kJ/h-person and sensible heat 400 kJ/h-person and the respective overall heat transfer coefficient for wall and ceiling 20 kJ/m^2-h.K and 10 kJ/m^2-h.K. Calculate SHF for the banking building and the capacity of the refrigeration system. (Assume number of air changes = 2.8 and ventilation air requirement is 4.7×10^3 m^3/s-person). 25

8(a) What factors are to be considered in locating supply air outlets and return air inlets? 07

8(b) What is duct system? What are the losses occurred in the duct for air conditioning system? 08

8(c) For the duct system shown in figure, determine the dimensions of the rectangular ducts AB, BC, CD and DE with aspect ratio 3:1 assuming friction rate of 0.1 mm H_2O/m length duct. 20



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