KATHMANDU UNIVERSITY
End-Semester Examination
August, 2018

Marks scored:

Level : B.E.
Year : III

Course : MEEG 302
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date AUG 15 2018

SECTION "A"
[20 Q. × 1 = 20 marks]

Tick the most appropriate answer.

1. One ton of refrigeration is equal to
[ ] 21 kJ/min [ ] 210 kJ/min [ ] 420 kJ/min [ ] 620 kJ/kg

2. Air refrigeration cycle is used in
[ ] commercial refrigerators [ ] domestic refrigerators
[ ] air-conditioning [ ] gas liquefaction

3. In a refrigerating machine, heat rejected is_____heat absorbed.
[ ] equal to [ ] less than [ ] greater than [ ] depends

4. In a vapour compression refrigeration system the condition of refrigerant before entering the compressor is
[ ] saturated liquid [ ] wet vapour
[ ] saturated vapour [ ] superheated vapour

5. The highest temperature during the cycle in a vapour compression refrigeration system occurs after
[ ] compression [ ] condensation [ ] expansion [ ] evaporation

6. The sub cooling is a process of cooling the refrigerant in vapour compression refrigeration system
[ ] before compression [ ] after compression
[ ] before throttling [ ] after throttling

7. The moisture in a refrigerant is removed by
[ ] evaporator [ ] safety relief valve
[ ] dehumidifier [ ] driers

8. Domestic refrigerator working on vapour compression cycle uses the following type of expansion device
[ ] electronic valve [ ]manually operated valve
[ ] thermostatic valve [ ] capillary tube

9. If T_1 and T_2 be the highest and lowest absolute temperature encountered in a refrigerator working on a reversed Carnot cycle, than COP is equal to
[ ] T1/ (T1 - T2) [ ] T2 / (T1 - T2)
[ ] (T1 - T2) / T2 [ ] (T1 - T2) / T1

10. In a refrigeration cycle flow of refrigerant is controlled by
[ ] compressor [ ] condenser
[ ] evaporator [ ] expansion valve

11. In summer comfort cooling, air in the occupied space should not have a relative humidity above
[ ] 30 % [ ] 40 % [ ] 50 % [ ] 60 %

12. The vertical and uniformly spaced lines on a psychometric chart indicates
[ ] dry bulb temperature [ ] wet bulb temperature
[ ] dew point temperature [ ] specific humidity

13. The minimum temperature to which moist air can cooled under ideal conditions in a spray washer is
[ ] dew point temperature of inlet air [ ] wet bulb temperature of inlet air
[ ] water inlet temperature [ ] water outlet temperature

14. The temperature of air recorded by a thermometer when it is not affected by the moisture present in it is called
[ ] wet bulb temperature [ ] dry bulb temperature
[ ] dew point temperature [ ] none of these

15. The degree of warmth or cold felt by a human body depends mainly on
[ ] dry bulb temperature [ ] relative humidity
[ ] air velocity [ ] all of these

16. The index which correlates combined effects of air temperature, relative humidity and air velocity on the human body is known as
[ ] mean radiant temperature [ ] effective temperature
[ ] average temperature [ ] none of these

17. The optimum effective temperature for human comfort is
[ ] higher in winter than in summer [ ] lower in winter than in summer
[ ] same in winter and summer [ ] depends on other factors

18. Waste heat can be effectively used in which one of the following refrigeration systems
[ ] vapour compression system [ ] vapour absorption system
[ ] air refrigeration system [ ] vortex refrigeration system

19. Which of the following parameter remains constant during adiabatic saturation process of unsaturated air?
[ ] wet bulb temperature [ ] dry bulb temperature
[ ] dew point temperature [ ] relative humidity

20. The relative humidity during sensible cooling process
[ ] increases [ ] decreases
[ ] remains same [ ] unpredictable

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Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

Course: MEEG 302
Semester: II
F.M. : 55

SECTION "B"
[55 marks]

Attempt *ALL* questions. Assume suitable data if necessary. Psychrometric chart is attached. Use it where applicable. Chart has to be attached with answer sheet.

Q.N.1

You have been given the task of designing an air-conditioning system for a facility with given information.

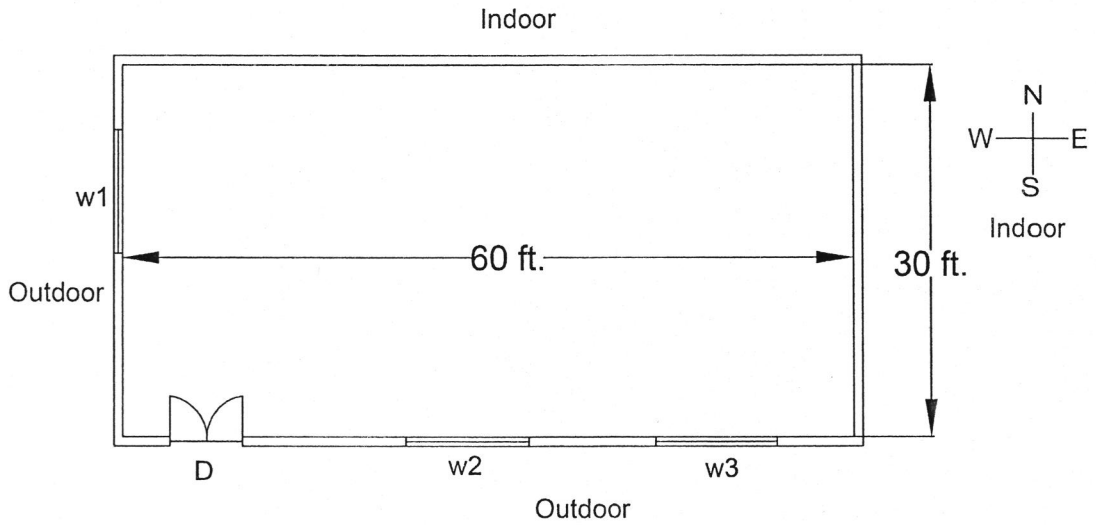

Figure 1: Plan for the restaurant

Facility: Restaurant
Location: Baneshwor, Kathmandu
Height of the building is 15 ft
Wall: Wall is made of 9 inches thick brick wall, thermal conductivity of brick is 1.0 W/mK
Windows: All windows (w1, w2, w3) are of same size (10 ft. x 6 ft.), single glazing glass with thickness 0.5 inches and thermal conductivity 0.96 W/mK and shading coefficient 0.98
Door: Door (D) is made of glass with size (8 ft. x 6 ft.) and thickness 2 inches, thermal conductivity is 0.96 W/mK
Adjacent indoor rooms, upper floors are air-conditioned, assume no heat transfer to the floor
Outdoor conditions: 33 ^{0}C DBT and 60 % rh
Indoor conditions to be maintained: 22 ^{0}C and 50 % rh
Number of occupants: 100
Ventilation required: 7.5 CFM per person and 0.18 CFM per square feet
Infiltration: 0.5 Air changes per hour
Sensible and latent heat gain per occupant is 75 W and 55 W respectively
Appliance and Lighting heat gain: 2 kW
Convective heat transfer coefficients for inside and outside conditions are: 10 W/m^{2}K and 30 W/m^{2}K respectively
For conversion: 1 sq. m = 10.76 sq. ft, 1000 CFM = 0.4719 m^3/s

The design is made for hot summer day with solar heat gain factor and Cooling Load Temperature Differential as:

Direction	SHGF, W/m^2	CLTD, ^0C
North	129	15
South	122	29
East	114	17
West	462	23

Calculate the following:

a. Total heat gain through walls in kW [3]
b. Total heat gain through fenestration in kW (*including solar heat gain*) [3]
c. Heat gain due to ventilation in kW [3]
d. Heat gain due to infiltration in kW [3]
e. Heat gain due to occupants in kW [1]
f. Total cooling load required in TR [1]

Selection of air-conditioning system

The client is considering using either a Variable Refrigerant Flow, VRF System or Chiller System for air-conditioning the facility. In this context,

g. Write down two advantages and two disadvantages of variable refrigerant flow system [2]
h. Write down two advantages and two disadvantages of chiller system. [2]
i. Suggest the air-conditioning system for the facility to the client based on your judgment. Give reasons for your selection. [1]

Design of ventilation duct

Ventilation system consists of a cooling coil for processing of outdoor air. Outdoor air is cooled and dehumidified by the cooling coil to match indoor conditions i.e. 22 ^0C DBT and 50 % rh. This air is than supplied into the facility by duct system.

j. Calculate sensible heat factor for the cooling coil. [3]
k. A rectangular duct of size 300 mmx 250 mm and 9 meters long is used. Calculate the pressure drop in the duct in Pa and capacity of fan in Watts, if Darcyfriction factor is 0.019. [4]

Q.N.2

Draw a sketch of vapour compression refrigeration System with P-h, and T-s diagram. Write down its main processes and explain briefly the working principle. [5]

Q.N.3

In an ideal air refrigeration cycle operating between pressure limit of 1 bar and 5 bar, temperature of air entering the compressor and expander are 10 ^0C and 25 ^0C respectively. If the expansion and compression follow the law $PV^{1.3}$ = constant, Find

a. Theoretical COP of the cycle. [4]
b. Mass flow rate of air in kg/min if actual COP is 50 % of ideal COP and cooling load on refrigerator is 10 TR. [2]

Q.N.4

Write short notes on

a. Applications of refrigeration in food preservation [6]
b. Physiology of heat loss from human body [6]
c. Thermal comfort [6]

MEEG 502 – Table IV-1-1.

PSYCHROMETRIC CHART

Normal Temperature

SI Units

SEA LEVEL

BAROMETRIC PRESSURE: 101.325 kPa

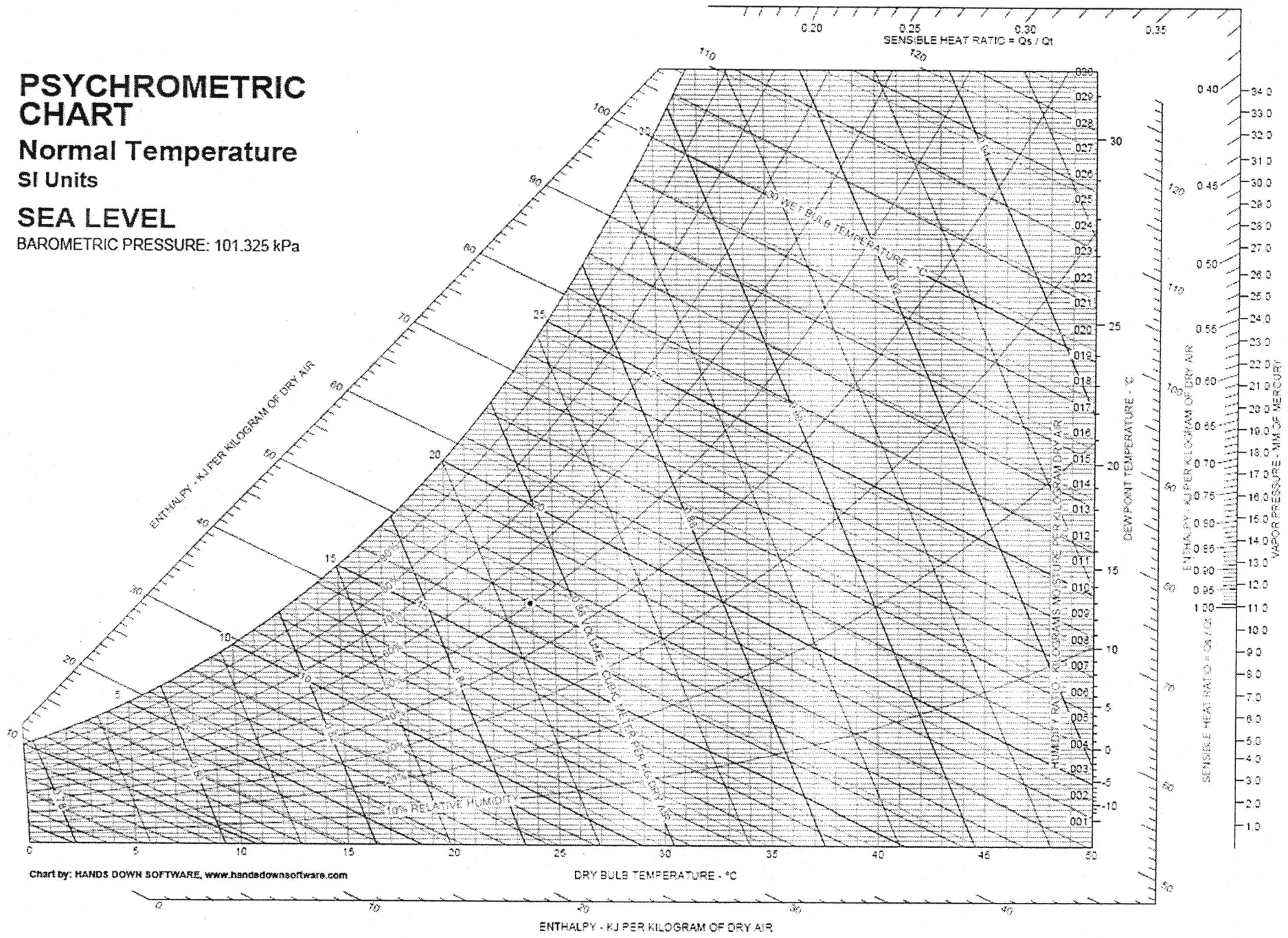

Chart by: HANDS DOWN SOFTWARE, www.handsdownsoftware.com

AUG 15 2010