KATHMANDU UNIVERSITY
End Semester Examination [C]
11, April, 2023

Marks Scored:

Level : B.E.
Year : IV
Course : MEPP 403
Semester: I

Exam Roll No. :
Time: 30 mins.
F.M. : 20

Registration No.:
Date :

SECTION "A"
[20Q. × 1 = 20 marks]

Choose the most appropriate answer and **mark [X]** in the box.

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

2. Which one is not a refrigerant flow control device
[ ] electronic expansion valve [ ] float valve
[ ] thermostatic valve [ ] capillary tube

3. A Carnot heat pump operates between 200 K and 250 K. Its coefficient of performance is
[ ] 5.0 [ ] 4.0 [ ] 1.2 [ ] 0.8

4. For a simple vapour compression cycle, enthalpy at suction is 1600 kJ/kg, enthalpy at discharge from the compressor is 1800 kJ/kg and enthalpy at exit from condenser is 600 kJ/kg. What is the highest possible COP for the cycle?
[ ] 6.0 [ ] 7.5 [ ] 5.0 [ ] 4.5

5. Condensation process in vapour compression refrigeration cycle is carried out at
[ ] constant volume [ ] constant pressure
[ ] constant enthalpy [ ] none of the above

6. Which fluid properties in all its three phase are made use of in thermodynamics?
[ ] Ammonia [ ] Water [ ] Feron 12 [ ] Helium

7. In milk chilling plants, the usual secondary refrigerant is
[ ] Sodium silicate [ ] Propylene glycol
[ ] Brine [ ] Ammonia solution

8. Two-stage compressor takes in air at 1.1 bar and discharges at 20 bar. For maximum efficiency, the intermediate pressure in bar is:
[ ] 10.55 [ ] 7.33 [ ] 4.7 [ ] 5.5

9. In a 0.5 TR capacity water cooler, water enters and 30°C and leaves at 15°C. What is the actual water flow rate in kg per hour?
[ ] 50 [ ] 75 [ ] 100 [ ] 125

10. Which of the process is not present in vapour compression refrigeration system?
[ ] isothermal [ ] isentropic [ ] isobaric [ ] isochoric

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

12. 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

13. 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

14. Which are the two types of heat transfer taking place during ventilation of a building?
[ ] latent and radiant [ ] latent and sensible
[ ] latent and conduction [ ] sensible and radiant

15. Air at 10°C is heated to 15°C using a heater with surface temperature of 20°C. The by-pass factor is
[ ] 0.5 [ ] 0.15 [ ] 0.1 [ ] 0.2

16. What does FCU air-conditioning system stand for?
[ ] full conditioning unit [ ] fan coil unit
[ ] full compressor unit [ ] failed compressor unit

17. Which is correct for sensible heating processes on a psychrometric chart?
[ ] curved line between two dry-bulb temperatures
[ ] vertical straight line
[ ] any line at 45◦ to the horizontal
[ ] horizontal line

18. For a room sensible heat factor is 0.8. If total cooling load of the room is 5 kJ/min what is the latent cooling required.
[ ] 4 kJ/min [ ] 2 kJ/min [ ] 1 kJ/min [ ] 0.8 kJ/min

19. The reason for a person feeling more comfortable on a warm day if seated in front of an electric fan is that the
[ ] metabolic heat production is reduced
[ ] body loses more heat by convection and evaporation
[ ] body loses more heat by radiation
[ ] body loses more heat by evaporation and radiation

20. Most commonly used method for duct design and sizing is
[ ] velocity reduction method [ ] static regain method
[ ] equal friction method [ ] dual duct method

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F. M. : 55

SECTION "B"

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

1.

a. Describe working of vapour compression refrigeration cycle with a schematic, P-h and T-v diagrams. [6]

b. A dense air refrigeration cycle operates between pressures of 4 bar and 16 bar. The air temperature after heat rejection to surroundings is 37°C and air temperature at exit of refrigeration is 7°C. The isentropic efficiencies of turbine and compressor are 0.85 and 0.8 respectively. Determine compressor and turbine workdone in kJ/kg and C.O.P of the system. Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg.K. [5]

2.

a. Write down the limitations for single stage compression. Describe working of cascade system in details. [6]

b. A water cooler for drinking water should cool 25 ml/s water from 18°C to 10°C while the water reservoirs also gain 60 W from heat transfer. Assume that a refrigeration unit with a COP of 2.5 does the cooling. Find the total rate of cooling required and the power input to the unit. [5]

3.

a. Define the terms dry bulb temperature, specific humidity, specific enthalpy of air and by pass factor. [4]

b. Based on equal friction method construct a methodology of calculating duct size for and air-conditioning application. [5]

4. Describe in details, methods of calculating following cooling load components for a building facility. [4+4+4]
   a. Wall heat gain/loss
   b. Heat gain/loss due to Ventilation
   c. Heat gain/loss due to fenestration

5. A room is air conditioned by a system that maintains 24°C DBT and 50% rh inside, when the outside conditions are 34°C DBT and 40% rh. The room sensible and latent heat gains are 60 kW and 12 kW respectively. The outside fresh air flows over a cooling coil and is cooled to 10°C DBT and 85% rh. It is then mixed with recirculated air, the mixture being handled by a fan, passed over a second cooler coil and sensibly cooled to 12°C DBT. The air is then delivered to the room. If the mass flow rates of fresh air and recirculated air are 1.73 kg/s and 3.164 kg/s respectively. Find [12]
   a. DBT and enthalpy of the air handled by the fan
   b. State of air supplied to the room
   c. cooling capacity of first cooling coil and second sensible cooling coil.