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**B.TECH,
(SEM VII) THEORY EXAMINATION 2021-22
HVAC SYSTEMS**

*Time: 3 Hours**Total Marks: 100*

- Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.
2. Use of Refrigeration table, steam table and .

SECTION A

 $2 \times 10 = 20$

1. Attempt all questions in brief.

- a. What are future refrigerants?
- b. What do you understand by Greenhouse effect?
- c. Explain the importance of Alignment circle. In psychrometric chart.
- d. Explain ADP.
- e. What is performance index of a heat pump? How is it related to COP of a refrigerator?
- f. Differentiate between natural ventilation and mechanical ventilation.
- g. Explain evaporative cooling.
- h. What is sol air temperature?
- i. Explain the role of duct in air-conditioning systems.
- j. Suggest materials used in fabrication of ducts.

SECTION B

 $10 \times 3 = 30$

2. Attempt any three of the following:

- a. A refrigerator working on an ideal vapor compression cycle uses refrigerant R-12. The minimum and maximum pressures of the cycle are 0.15 MPa and 0.9 MPa respectively. If the mass flow rate of the refrigerant is 0.045 kg/s, determine:
 - (i) The rate of heat removal from the refrigerated space
 - (ii) Power input to the compressor
 - (iii) The rate of heat rejection to the environment
 - (iv) COP of the system
- b. The moist air at 10°C and 50% relative humidity enters a steam heating coil at the rate of 50 kg/s and the temperature at the exit is noted to be 30°C. Determine:
 - (i) Sensible heat transfer
 - (ii) Mass flow rate of steam if it enters saturated at 100°C and the condensate leaves at 65°C.
- c. Differentiate among all water, all air and air water air-conditioning systems.
- d. With neat sketch, explain how Centralized air-conditioning systems differ from Unitary air-conditioning system.
- e. Classify the ducts on the basis of its application, pressure inside it and the velocity of air in the duct.

SECTION C

 $10 \times 1 = 10$

3. Attempt any one part of the following:

- (a) Explain the effects of superheating, subcooling and reduction in condenser pressure on the COP of the vapor compression refrigeration system.



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(b) Explain classification of refrigerants in detail.

4. Attempt any one part of the following:

10 x 1 = 10

- (a) 400 m³/min of air at 20°C DBT coming out from air-conditioned hall is mixed with 150 m³/min of fresh air at 35°C DBT and 45% RH adiabatically. Determine: (i) enthalpy (ii) specific humidity (iii) specific volume and (iv) DPT of the mixture.
- (b) Define human comfort. Explain the factors affecting human comfort.

5. Attempt any one part of the following:

10 x 1 = 10

- (a) Classify heat pumps. Also explain any one type of it.
- (b) Explain different components of Central Air-conditioning system.

6. Attempt any one part of the following:

10 x 1 = 10

- (a) Explain the procedure to estimate the cooling load with the help of suitable example.
- (b) A seminar hall for seating 250 persons is to be maintained at 22°C DBT and 50% R.H. The outside air conditions are 40°C DBT and 27°C WBT. The various loads in the auditorium are as follows:
Sensible and latent heat loads per person, 80 W and 50 W respectively;
Lights and fans, 15000 W;
Sensible heat gain through glass, walls, ceiling etc., 12000 W;
The air infiltration is 30 m³/min;
Determine room sensible heat factor.

7. Attempt any one part of the following:

10 x 1 = 10

- (a) Compare the characteristic of backward and Forward Curved blade vanes with the help of suitable sketches.
- (b) The main air supply duct of an air conditioning system is 800 mm × 600 mm in cross-section and carries 300 m³/min of standard air. It branches into two ducts of cross-section 600 mm × 500 mm and 600 mm × 400 mm. If the mean velocity in the larger branch is 480 m/min, find:
1. Mean velocity in the main duct and the smaller branch, and
2. Mean velocity pressure in each duct.