

B.TECH.
(SEM VII) THEORY EXAMINATION 2022-23
HVAC SYSTEMS

Time: 3 Hours

Total Marks: 100

Note: Attempt all Sections. If you require any missing data, then choose suitably.
Use of refrigeration table and steam table is permitted.

SECTION A

1. Attempt all questions in brief. 2x10 = 20

- (a) Explain the process of chemical dehumidification.
- (b) How can moisture be removed from a refrigeration system?
- (c) Mention the significance of alignment circle on a psychometric chart.
- (d) What is Effective Sensible Heat Factor?
- (e) What is auto refrigeration?
- (f) Define effective temperature. Explain its utility in comfort air conditioning.
- (g) What is human comfort according to ASHRAE?
- (h) Explain the importance of sol air temperature in cooling load calculations.
- (i) Which type of duct is normally preferred in air conditioning?
- (j) Define specific speed of a centrifugal fan.

SECTION B

2. Attempt any three of the following: 10x3 = 30

- (a) What are the desirable properties of an ideal refrigerant?
- (b) Illustrate the advantages and disadvantages of mechanical ventilation over natural ventilation?
- (c) Analyze the factors that determine human comfort.
- (d) Discuss the different types of heat loads which are taken into account in order to estimate the total heat load of a large restaurant for summer air conditioning.
- (e) Describe the different methods of air conditioning duct design.

SECTION C

3. Attempt any one part of the following: 10x1 = 10

- (a) Derive the expression for COP of a refrigerating system consisting of three evaporators at the same temperature with single compressor and expansion valve.
- (b) What are azeotropic and non-azeotropic mixtures? Explain, in brief, their advantages giving examples.

4. **Attempt any *one* part of the following:** **10 x1 = 10**
- (a) Explain the various industrial applications of air conditioning.
 - (b) Explain with a neat sketch, working of an underground heat pump.
5. **Attempt any *one* part of the following:** **10x1 = 10**
- (a) Compare all-water, all-air and air-water air conditioning systems.
 - (b) With the help of neat sketches, explain how unitary system differ from central air conditioner.
6. **Attempt any *one* part of the following:** **10x1 = 10**
- (a) A quantity of air having a volume of 300 m^3 at 30°C D.B.T. and 25°C W.B.T. is heated to 40°C D.B.T. Estimate the amount of heat added, final R.H. and W.B.T.
 - (b) In a heating application, moist air enters a steam heating coil at 10°C , 50% RH and leaves at 30°C . Determine the sensible heat transfer, if mass flow rate of air is 100 kg of dry air per second. Also determine the steam mass flow rate if steam enters saturated at 100°C and condensate leaves at 80°C .
7. **Attempt any *one* part of the following:** **10x1 = 10**
- (a) A stream of air at 20°C , 90% relative humidity and flowing at the rate of $5 \text{ m}^3/\text{min}$ mixes adiabatically with another air with corresponding parameters of 30°C , 50% and $20 \text{ m}^3/\text{min}$. Presuming that both the streams are at 760 mm of mercury pressure, determine the following parameters for the mixed stream:
 - (a) dry and wet bulb temperature,
 - (b) relative humidity and specific humidity.
 - (b) The following data refer to a bank for 100 persons in the premises:

Ambient conditions:	37°C DBT and 27°C WBT
Required inside conditions:	22°C DBT and 60% RH
Sensible heat:	110 kW
Latent heat:	55 kW
Ventilation requirement:	$0.0047 \text{ m}^3/\text{sec}$ per person.

If the bypass factor for the coil is 0.15, make calculations for:
 - (a) grand total heat,
 - (b) effective sensible heat factor,
 - (c) apparatus dew point, and
 - (d) volume flow rate of humidified air.