

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – WINTER • 2014****Subject code: 1721003****Date: 04-12-2014****Subject Name: Advanced Air Conditioning****Time: 02:30 pm - 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Air enters an air conditioner of 1.5 ton capacity at a rate $0.3\text{ m}^3/\text{s}$ having $T_{db}=26^\circ\text{C}$ and $\phi=70\%$. It leaves at 19°C after being cooled and dehumidified. Determine (a) final state of air, (b) rate of dehumidification of air, (c) volume of air flowing out of the grille. Show the state points on the psychrometric chart. 7
- (b) A fan supplied air across a cooling coil of 15 ton capacity. The air enters at $T_{db}=30^\circ\text{C}$ and $\phi=60\%$ and leaves at $T_{db}=24^\circ\text{C}$ and $\phi=50\%$. The catalogue of fan shows that it delivers $2.5\text{ m}^3/\text{s}$ against a pressure of 500 N/m^2 when operates at 10 RPS. Determine the fan (a) speed (b) pressure drop and power input to it if its overall efficiency is 0.8. 7
- Q.2** (a) The following data refer to a 200 capacity theatre. Room conditioning: $T_{db}=26^\circ\text{C}$, $\phi=50\%$, Room dimension $15\text{m}\times 10\text{m}\times 10\text{m}$ high with 15m side as EW oriented. Outside condition: $T_{db}=42^\circ\text{C}$, $w=0.02\text{ kg/kg}$ of dry air. $U_{\text{wall}}=4\text{ kJ/m}^2\text{-h-K}$ (for south and north), $U_{\text{wall}}=2.4\text{ kJ/m}^2\text{-h-K}$ (for east-west) $U_{\text{ceiling}}=3\text{ kJ/m}^2\text{-h-K}$, $U_{\text{door}}=3\text{ kJ/m}^2\text{-h-K}$. Door size $2\text{m}\times 1\text{m}$ on the north. Solar radiation amounts of 19.5% of the structure heat load. No smoking and ventilation air equal to the makeup air. Air enters the theatre at 17°C . Sensible energy release from persons is 60% of the total energy release and rest as latent heat. The makeup air is mixed before the coil. Electrical appliances inside the room equivalent to 3 KW. Duct and blower heat gains are equivalent to 8000 KJ/h and 4KW respectively. Assume 2.8 air changes per hour and ventilation standard $3.6 \times 10^{-3}\text{ m}^3$ per person per person. Determine: (a) SHF of the room (b) amount of ventilation air (c) establish the state of air entering the theatre (d) amount of air supply to theatre (e) state of air at blower exit (f) state of air leaving the cooling (g) mixture air state (h) GSHF and ADP (i) bypass factor and (j) tonnage of the cooling coil. 7
- (b) The following data is available for the air conditioned room. Outside design condition: 35°C DBT, 25°C WBT. Inside design condition 21°C DBT, 70% RH. R.S.H. = 46.5 kW, R.L.W. = 2.9kW. Ventilation air $=108\text{ m}^3/\text{min}$. Assuming B.F.=0.05 calculate (a) outside air loads (b) grand total heat (c) ESHF (d) Coil apparatus dew point (e) Dehumidified air quantity (f) Entering and leaving air condition (g) RSHF (h) GSHF. 7
- OR**
- (b) Derive the following equation for diameter of equivalent round duct 7
- $$d_e = \frac{1.3(a \times b)^{0.625}}{[a + b]^{0.25}}$$
- Q.3** (a) Write brief note on testing of desert coolers as per B.I.S. 7
- (b) Explain the following terms, 7
- (i) Air dew point (ii) Room A.D.P. (iii) Coil A.D.P. (iv) By-pass factor and contact factor.

OR

- Q.3** (a) Explain the following 7
 (i) Infiltration and ventilation (ii) Equivalent temperature difference (iii) I.C.L. and I.G.L. (iv) Reduction of heat gain through glass.
 (b) Prove with usual notations 7

$$t_{and} = 0.4171 / SHF - 1]$$
- Q.4** (a) State and explain economic factors influencing duct layout. 7
 (b) Explain factors affecting grill performance? Differentiate between grill and diffuser. 7
OR
- Q.4** (a) Derive an expression for calculating makeup water and leaving water temperature required for cooling tower. 7
 (b) Explain effective temperature? State and explain factors affecting effective temperature. 7
- Q.5** (a) State and explain following controls, 7
 1) Damper control
 2) Motor control
 (b) Sketch a typical A.H.U and explain its construction and working. 7
OR
- Q.5** (a) State and explain fan laws. 7
 (b) Explain dual duct VAV system and represent it on psychometric chart. 7
