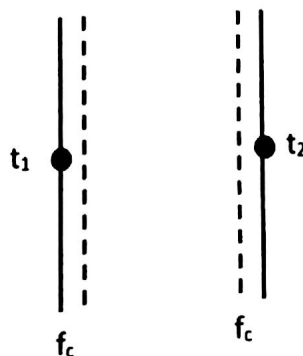Maximum Marks- 10

1. Choose the correct answer from the following (more than one option may be correct)

[5]

1. The shape factor for two nonparallel identical surfaces is:
   a. One
   b. Ten
   c. Less than one
   d. Infinity

2. Equivalent Temperature Difference (ETD) or Cooling Load Temperature Difference (CLTD) is dependent on-
   a. Decrement and Time lag factors
   b. Solar radiation and outside ambient temperature ✓
   c. Inside air temperature
   d. All of the above

3. In solar air temperature-
   a. Both convection and radiation are considered ✓
   b. Only convection is considered
   c. Only radiation is considered
   d. Is independent of convection and radiation

4. For the following arrangement of two parallel walls both having convective heat transfer coefficients f_c and maintained at temperatures t_1 and t_2 ($t_1 > t_2$), the convective heat transfer flux is given by-

   a. $0.5 f_c (t_1-t_2)$ ✓
   b. $f_c (t_1-t_2)$
   c. $1.5 f_c (t_1-t_2)$
   d. $2 f_c (t_1-t_2)$ ✓

5. Heat is conducted through a compound plate composed of two parallel plates of different materials A and B of conductivities 0.32 and 0.14 and of thickness 3.6 and 4.2 cm respectively. If the temperatures of the outer face of the slab A and that of slab B are found to be steady at 96°C and 8°C respectively, the temperature of interface A/B is-

   a. 52 °C
   b. 62 °C
   c. 72 °C
   d. 22 °C

2. A building has its north, west facing walls and the roofs exposed to sun. The dimensions of the building are 11 m ×10 m×7 m (W×L×H). The U-value of the walls are 0.45 W/m²K, while it is 0.35 W/m² K for the roof. There are no windows on the north and west walls, and the other two walls are exposed to air conditioned spaces. The outside design temperature is 38°C while the indoor is maintained at 22°C, while the average temperature for the design day is 31°C. Calculate heat transfer rate to the building at 2 PM and 6 PM. Assume the roof is of Type 4 and the walls are of D-Type as per ASHRAE building codes. **While calculating the areas for the walls clearly mention the directions (North and West) of the walls against their dimensions.**

[5]

CLTD VALUES (K) FOR FLAT ROOFS WITHOUT SUSPENDED CEILINGS BY ASHRAE HANDBOOK

Roof type	Mass per unit area, kg/m²	Heat capacity, kJ/m².K	Solar Time, h													
			07	08	09	10	11	12	13	14	15	16	17	18	19	20
3	90	90	-2	1	5	11	18	25	31	36	39	40	40	37	32	25
4	150	120	1	0	2	4	8	13	18	24	29	33	35	36	35	32
5	250	230	4	4	6	8	11	15	18	22	25	28	29	30	29	27
6	365	330	9	8	7	8	8	10	12	15	18	20	22	24	25	26

Description of Roof types:

Type 3: 100 mm thick, lightweight concrete

Type 4: 150 mm thick, lightweight concrete

Type 5: 100 mm thick, heavyweight concrete

Type 6: Roof terrace systems

CLTD VALUES (K) FOR D TYPE WALLS ASHRAE HANDBOOK

Solar Time,h	Orientation							
	N	NE	E	SE	S	SW	W	NW
7	3	4	5	5	4	6	7	6
8	3	4	5	5	4	5	6	5
9	3	6	7	5	3	5	5	4
10	3	8	10	7	3	4	5	4
11	4	10	13	10	4	4	5	4
12	4	11	15	12	5	5	5	4
13	5	12	17	14	7	6	6	5
14	6	13	18	16	9	7	6	6
15	6	13	18	17	11	9	8	7
16	7	13	18	18	13	12	10	8
17	8	14	18	18	15	15	13	10
18	9	14	18	18	16	18	17	12
19	10	14	17	17	16	20	20	15
20	11	13	17	17	16	21	22	17
CLTD$_{max}$	11	14	18	18	16	21	23	18

$$CLTD_{corrected} = CLTD_{Table} + (25 - T_i) + (T_{av} - 29)$$

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