

DEPARTMENT OF CIVIL ENGINEERING: IIT DELHI
CVL875: SUSTAINABLE MATERIALS AND GREEN BUILDINGS. MAJOR TEST
DURATION: 2.0 Hours. SECOND SEMESTER- 2022-2023. Max. Marks: 40
DATE:- 02/05/2023 TIME:- 14.0 P.M. 16.0 PM Venue: LH 512

All relevant charts if required are supplied and only chart supplied need be used.
DRAW DIAGRAMS TO EXPLAIN YOUR ANSWER WHERE-EVER REQUIRED
BE BRIEF AND ANSWER TO THE POINT
ASSUME MISSING DATA SUITABLY IF REQUIRED

1. Why formaldehyde is considered to be hazardous for human health? Consider a room size $4 \times 5 \times 3.5 \text{ m}^3$. The VOC concentration in the room is 5 mg/liter at an instant. The VOC diffuses from various items in the room. If the rate of air change due to ventilation and infiltration is 3 times the room volume /hour, how much VOC will move out of the room at that instant? At some instant VOC concentration is 10 mg/liter and instantaneously all VOC sources are removed from the above room. Obtain an equation for concentration with time for above room and calculate the concentration after 1 hour from that instant of removal? 8
2. List the aspects on which LEED credits are distributed along with their relative weightages. 8
3. Supposing you are considering U-value of walls, shape and orientations as the only decision variables and you have 16 options of U-values, 8 options of shape and orientation each. You are using GA for energy optimization; Write the chromosome strings of two individual parents respectively having 3rd and 5th U-values; 1st and 8th shapes, and 2nd and 4th orientation. For a cross-over exactly at mid string location, what will be the two next generation off-springs? 4
4. State and Expression for OTTV and explain all its terms as applicable to tropical climates. For walls of area 20 m^2 + glass area of 10 m^2 the U value of the solid wall is $3.4 \text{ W/m}^2\text{°C}$, absorptivity being 0.4, with TD equivalent of 10°C and U of fenestration being $0.7 \text{ W/m}^2\text{°C}$ with temperature differential of 15°C , shading coefficient is 0.5 and solar factor of 0.8 what is the OTTV of the wall? 6
5. What is albedo? Consider albedo of concrete as 0.3 and emissivity is 0.9; direct and diffused radiation on horizontal surface is 400 W/m^2 and 100 W/m^2 respectively; Equivalent temperature of concrete is 25°C , Stefan-Boltzmann's constant $5.7 \times 10^{-8} \text{ Wm}^{-2} \text{ K}^{-4}$ and longwave radiation from outer space is 150 W/m^2 , what is the net all wave radiation received at the earth surface per sq.m at the location of interest? 5
6. a) A brick has porosity of 10%. Thermal conductivity of the solid is estimated to be 2 W/mK , and those of air and water are 0.025 W/m°C and 0.625 W/m°C . Calculate the possible range of dry and saturated conductivities based on Ohms law model. 4
b) State relationship between relative thermal conductivity and degree of saturation, assume suitable constant coefficients and estimate conductivity at 50% degree of saturation for dry conductivity 0.4 W/mK and saturated conductivity 1.6 W/mK 3

$$k = k_s(1-p) + \frac{k_p}{p}$$

7. Given the following data calculate the planet equivalent

3

Ecological Footprint Biocapacity

8. What are components of embodied energy? explain how durability is related to life cycle embodied energy?

3

<u>GHA</u>	<u>GHA</u>	<u>Bio. Capacity</u>
Carbon	7253000	
orchard.	3040000	3305000
Built up area	483000	483000
Grazing Area	914000	1683000
Fishing ground	936000	869000
Forest	1438000	4808000

Ecological Footprint
Bio Capacity

1400
17064000
11490000
1.26