WEEK-4

Q1.

A wood frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400 mm. The 90 mm wide cavity between the studs is filled with glass fiber insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm wood fiberboard and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75 % of the heat transmission area while the studs, plates, and sills constitute 21 percent. The headers constitute 4 percent of the area, and they can be treated as studs. Find the two R_{unit} values and determine the overall unit thermal resistance and the overall heat transfer coefficient (U).

Determine the rate of heat loss through the walls of a house whose perimeter is 50 meter and the wall height is 2, 5 m in Las Vegas (Nevada), whose winter design temperature is -2°C. Take the indoor design temperature to be 22°C and assume 20 % of the wall area is occupied by glazing.

ANS:

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13*200mm)	0.14	0.14
Plywood(13mm)	0.11	0.11
Urethane Rigif Foam (90mm)	X	0.98*90/25=3.528
Wood Studs (90mm)	0.63	X
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$Area$ A $=50*2.5*0.8 = 100m^2$

Change in temperature $\Delta T = 22-(-2) = 24°C$

R' with wood = (0.03+0.14+0.11+0.63+0.079+0.12) = 1.109 $m^2°C$ /W

R with insulation = (0.03+0.14+0.11+3.528+0.079+0.12) = 4.007 $m^2°C$ /W

U wood = $1/R'_{with\ wood}$ = 1/1.109= 0.9017 $m^2°C$ /W

U insulation = $1/R'_{with\ insulation}$ = 1/4.007=0.2496 $m^2°C$ /W

U total = $U_{wood} * (A_{wood}/A_{total})$ + $U_{insulation} * (A_{insulation}/A_{total})$

= (0.25 * 0.9017) + (0.75 * 0.2496) = 0.4126 $m^2°C$ /W

R value = $1/U_{total}$= 1/0.4126 = 2.4237 $m^2°C/W$

$Q_{total} = U_{total} * A_{total} * \Delta T$ = 0.4126 * 50 * 25 * (1−20%) * 22−(−2) = 990.24 W

Q2.

SUMMARY ABOUT RADIATION AND RADIATIVE HEAT TRANSFER

ANS:

Radiation is, the emission of energy in form of waves or particles through the space. The third type of heat transfer is radiation and it is different from conduction and convection because it does not require the presence of a material medium to take place.

Radiation transfer occurs in solid as well as liquid and gases.

Not all the waves are related to heat transfer, only thermal radiation emitted as a result of energy transitions of molecules, atoms, and electrons of a substance.

Thermal radiation is the emission of electromagnetic waves from all matter that has a temperature greater than absolute zero (0 K or -273,15°C), it is due to the heat of the material, the characteristics of which depend on its temperature. The type of electromagnetic radiation that is pertinent to heat transfer is the thermal radiation emitted as a result of energy transitions of molecules, atoms, and electrons of a substance.

And the rate of thermal radiation emission increases with increasing temperature.

The thermal radiation happens in all objects, like solid, liquid or gas, basically everything around us keeps emitting thermal radiation to its surroundings.

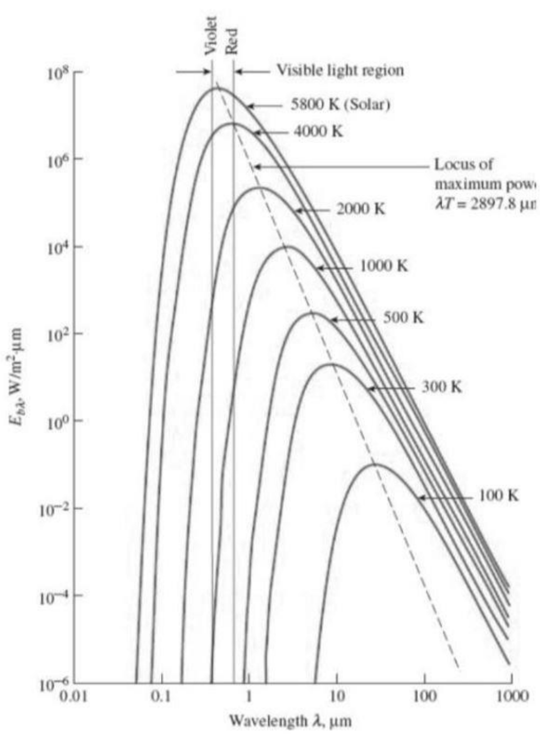
The thermal radiation can occur in vacuum because, the difference between thermal radiation and other mechanisms of heat transfer is, and thermal radiation does not need the presence of a material medium to take place.

The radiation energy emitted by a blackbody is calculated by:

E (T) = σT^4 (W/m^2)

σ = Stefan-Boltzmann constant,

T = temperature in K



The graphic is related to the variation of the **blackbody** emissive power with wavelength for several temperatures. It’s clearly seen how the emitted radiation is a continuous function of wavelength. At any specified temperature, it increases with wavelength, reaches a peak, and then decreases with increasing wavelength.

The temperature is important because at any wavelength, the increase in temperature resultants the increase in amount of emitted radiation.