Week Assignment 4

Question 1

Complete the modified example of simplified wall calculations that you went through in the assignment of week 3 and find the total heat transfer through wall.

Solution
Dimensions : 38mm , 90 mm
Center to center distance = 400mm
Insulation:
Thickness: 90mm
Filled with urethane rigid foam insulation
Inside finish :
13mm thick gypsum
Outside finish :
13mm polywood
13mm 200mm wood bevel lapped siding
T_{out} = -2°c
T_{in} = 22°c
20% wall area is glazing
Insulated cavity constitutes 75% of the heat transmission area
Studs, plates and sills constitute 21%

R_{unit} values

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13mm * 200mm)	0.14	0.14
Polywood (13mm)	0.11	0.11
Urethane rigid foam (90mm)	No	$\frac{0.98 * 90}{25}$ = 3.528
Wood studs (90mm)	0.63	No
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$R_{with\ wood}$ = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 $m^2 \frac{^\circ c}{w}$

$R_{with\ insulation}$ = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007 $m^2 \frac{^\circ c}{w}$

$U_{wood} = \frac{1}{R'wood} = \frac{1}{1.109} = 0.902\ \frac{w}{m2^\circ c}$

z

$U_{insulation} = \frac{1}{R'insulation} = \frac{1}{4.007} = 0.249 \ \frac{w}{m2°c}$

$U_{total} = U_{wood} * \frac{Awood}{Atotal} + U_{insulation} * \frac{Ainsulation}{Atotal}$

$= 0.25 * U_{wood} + 0.75 * U_{insulation}$

$= 0.25 * 0.902 + 0.75 * 0.249$

$= 0.2255 + 0.1867 = 0.4122 \ \frac{w}{m2°c}$

$Q_{total} = U_{total} * A_{total} * \Delta T$

$= 0.4122 * 100 * 24$
$= 989.28 \ W$

Question 2

Write a summary of what you have learnt in this session about radiation and radiative heat transfer.

Solution

Radiation heat transfer is a third type of heat transfer besides convection and conduction. Conduction and convection needs a medium to transfer the energy whereas radiation does not require a medium. The hot object in vacuum chamber/ air / closed environment will eventually cool down to reach the thermal equilibrium with the surroundings by ration heat transfer mechanism.
Thermal radiation is energy emitted by matter as electromagnetic waves. Every object with temperature above absolute zero will emit radiation (electromagnetic waves).
Therefore, it is a complex phenomenon and is not easy to generalize like conduction and convection.

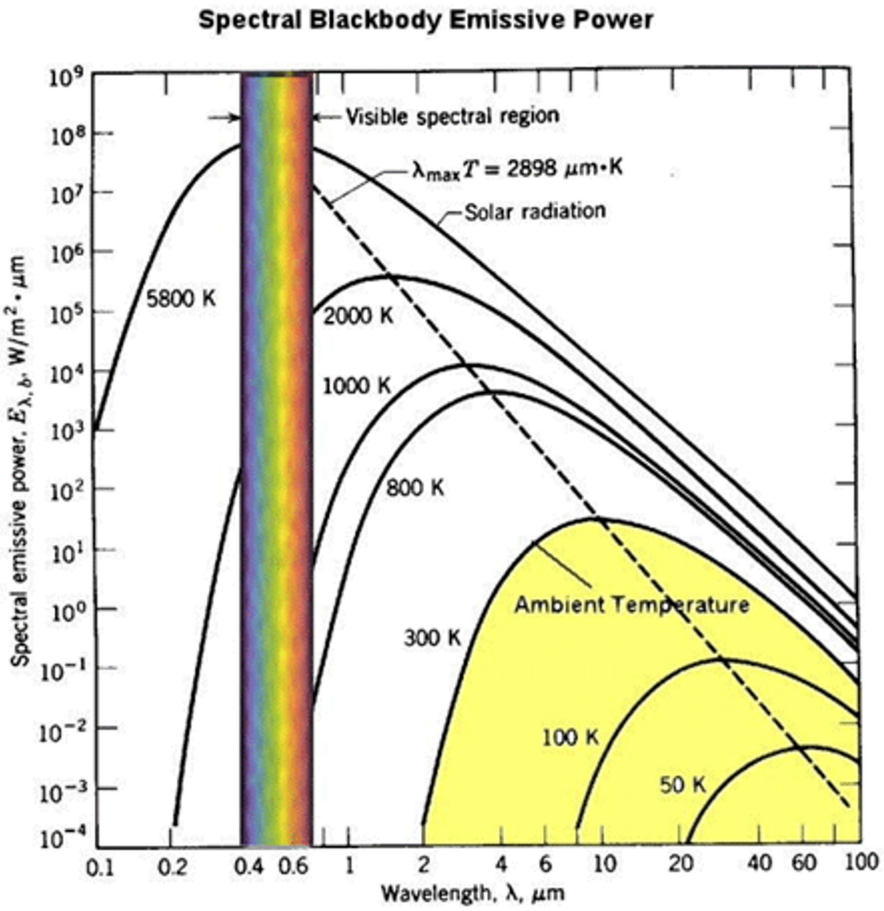
Radiation Energy: Electromagnetic waves transport energy just like other waves and they are characterized by frequency *v* or wavelength λ.
It is derived as :

$e = \frac{h\nu}{\lambda}$

Where e is energy of each photon
h is Planck's constant

Color of the light is characterized by frequency/wavelength for example red has lower frequency and long wave length so a person can see from long distance where as violet has high frequency and shorter wave length.
Black body: At a given temperature black body emits maximum amount of radiation. It is a perfect emitter and absorber of radiation. It emits uniformly whereas a real body emits the

radiation non uniformly.



As the temperature increases the radiation emitted increases along with the wavelength till certain level after that it starts decreasing with the increase in wavelength.

Surfaces at T< 800 k emit almost in the infrared region and thus are not visible to the eye unless the reflect light coming from the other source.