MECH3422 Building Services Engineering I

http://me.hku.hk/bse/MECH3422/

Exercise 02 -- Lighting Systems

Q.1 Which of the following applies to the eyes ability to see at low lighting level?
(a) Photopic vision (b) Scotopic vision (c) Myopic vision

Q.2 Brightness is a measurable quantity of light reflected from objects. (True or False)

Q.3 What are the four task parameters affecting visual performance?

Ans.: _____

Q.4 In the visual system, rods are:
(a) the photoreceptors that are less sensitive to light/dark than the cones.
(b) referred to as photopic vision.
(c) the photoreceptors responsible for night and peripheral vision.
(d) permitting us to perceive colour.

Q.5 In the Munnsell colour system, how saturated a colour appears is called:
(a) Hue (b) Value (c) Chroma

Q.6 Which light source would have the highest efficacy?
(a) Incandescent (b) Tungsten halogen (c) Fluorescent
(c) High pressure sodium (d) Metal halide

Q.7 Which horizontal surface contributes most to our impression of brightness?
(a) Floor (b) Ceiling (c) Workplane

Q.8 Utilisation factor (*UF*) is the ratio of total flux received by the surface to the total lamp flux of the installation. (True or False)

Q.9 A building will carry out a lighting retrofit to upgrade its fluorescent lamp ballasts. If the new ballasts will cost $100,000 to install and will generate an annual energy saving of 20,000 kWh for the lighting system. Assume electricity cost $1 per kWh, estimate the simple payback of the lighting retrofit.

Ans.: _____

Q.10 Give the requirements of the current EMSD's lighting energy code in Hong Kong.

Ans.: _____

Exercise 02 -- Lighting Systems (Lighting Calculations)

1. An office requires a lighting level of 500 lux from a regular array of louvred luminaries. Given the data below determine the following parameters:

   i) Room index and utilisation factor
   ii) Total lumens required
   iii) Number of luminaries required and a suitable layout
   iv) Space to height ratio (and check if it exceeds the limit)
   v) Actual total lamp output and illuminance level

   Given data:
   Room dimensions are: length 10 m, width 10 m, height 2.8 m
   Room reflectances: ceiling 0.7, walls 0.5, working plane cavity 0.2
   Working plane height = 0.8 m

   Table 1. Utilisation factor table

Utilisation Factor (*UF*) table for 0.7, 0.5, 0.2 reflectances (*RI* = room index)								
RI =	1.00	1.25	1.50	2.00	2.50	3.00	4.00	5.00
UF =	0.45	0.50	0.53	0.58	0.61	0.63	0.66	0.67

   Maintenance factor = 0.8
   Maximum space to height ratio = 1.75
   Luminaire versions available:
   2 x 1800 mm 70W (each lamp gives) 6550 lumens
   2 x 1500 mm 58W (each lamp gives) 5400 lumens

   [Ans.: *RI* = 2.5, *UF* = 0.61, 9 luminaries, layout 3 by 3]

2. A laboratory has dimensions 9 m (depth) x 9 m (width) x 3.4 m (height) and one single-glazed window of 4 m (width) x 2.5 m (height) on the exterior wall. The angle of sky component is 60 degrees, the maintenance factor is 0.75 and the reflection factor is 0.7. Determine the average daylight factor of this room.

   Given: $$DF = \frac{T \times G \times \theta \times MF}{A \times (1 - R^2)}$$

   where DF = average daylight factor (%)
   T = light transmittance (assume 0.85 for clear single glazing)
   G = glazed window area (m^2)
   θ = angle of sky component (degree)
   MF = maintenance factor
   A = total area of interior surfaces including windows (m^2)
   R = reflection factor

   If the window is changed to one double-glazed window (light transmittance is 0.5) of 5 m (width) x 2.4 m (height), what would the average daylight factor be?

   [Ans.: *DF* = 2.64%, when the window is changed to double-glazed *DF* = 1.86%]