18. Illumination Lesson AND Activity

Electrical Engineering (University of Rizal System)



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ILLUMINATION LESSON AND ACTIVITY (MRCTC ANSWER KEY)

P1.) A lamp gives an average output of 628 lumens. What is its M.S.C.P. ?

S1.) M.S.C.P. =Total Lumen No. of Lamp x 4 =6281 x 4=49.97 or **50**

P2) A lamp has a luminous intensity of 250 Cd. Calculate the total luminous flux emitted it.

S2) **1 Candela = 12.57lumens**

250Cd x 12.57 lumens1 Candela250 x 12.57lm

=3,142.5lm ≈ **3,142lm**

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P3) A light source has an illumination of 100 foot-candles (fc), what is the illumination in lux?

S3) 1foot-candle = 10.764 lux

$$100\ \text{foot} - \text{candles}(10.764\frac{\text{lux}}{1\text{foot} - \text{candle}}Ls(100fs) = 1074.6\ lux\ \cong \mathbf{1075\ lux}$$

P4) A light source which radiates light in all directions has a luminous intensity of 100 candela. What is the illumination E in footcandles in a perpendicular working area 10 ft distance below the source?

S4) $d^2 = 0^2 + 10^2 = 100$

$\Theta = \text{Tan}^{-1}(0/10) = 0°$

$E = I / d^2 \cos \Theta$

$= (100 / 100) \cos (0)$

E **= 1 footcandles or lux**

P5) A certain light source produces an illumination of 800 lux on a surface. Find the lumination on that surface if the distance to the light is doubled.

S5) $P = E/4\pi d^2$

$E = P4\pi d^2$

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$$P_1 4\pi d^2 = P_2 4\pi (2d)^2$$

$$8004\pi d^2 = P_2 4\pi (2d)^2$$

$$800 = 4P_2$$

$$P_2 = \mathbf{200\ lux}$$

P6) A lamp giving 200 candelas uniformly below the horizontal plane is suspended 3 m above a horizontal plane. Calculate the illumination at a point on the plane

S6) e

P7) an intensity of 100 candle power is directed at a point 10ft distance from the source. If the receiving plane is titled through 30 degrees from the perpendicular, what is the illumination upon the surface?

S7) FORMULA: Ep $(1/d^2)$ cos θ

$$\frac{100}{10^2}\cos(30\ degrees) = \mathbf{0.866\ fc}$$

P8) A 150 candlepower lamp gives sufficient light to read a book at a distance of 6 feet. If the lamp depreciates to 75 candlepower, how much closer should the book be placed to be read with the same illuminance in ft.?

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S8) Given:

Ep1=150 cd Ep2= 75 cd d1=6 ft

Required: d2= ?

Ep=Id2 ;

Ep1=Ep2

Ep1=I1d12=15062=4.17cd-ft

Ep1=Ep2

4.17cd-ft=75

cdd22 d=4.24 ft

d=6-4.24=1.76 or

1.8

Answer: D=1.8 ft

P9) An incandescent lamp having a luminous flux of 3000 is enclosed in a 0.3-meter diameter diffusing sphere and having an absorption factor of 15%. Calculate the average luminance of the sphere.

S9) Given: d

= 0.3 m

Lamp = 3000 lumens

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Therefore

P11) what must be the candle power of a point source of light which gives an illumination of 100 lm/m² at a point a 2m vertically below the source?

S11) Solution:

$Ep = I/d^2$

By deriving: $I = Ep(d)^2$

$I = 100(2)^2 =$ **400 Cd**

P12) if a plane mirror which reflects 75% of the light falling on it is placed horizontally 30cm above the source, what will be the illumination at A?

S12)

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P13) Two lamps A and B produce equal illumination on the screen of a photometer when A is 60 cm and B is 50 cm from the screen. A plane mirror is placed 6 cm behind B, the plane of the mirror being at right angles to the line from B to the screen and is then found that to restore equality of illumination on the screen, the source A must be moved 10 cm nearer the screen. What is the reflecting power of the mirror?

S13) **=** (60cm + 50cm / 6cm(10) + 10cm(10)) x 100%

= (110cm / 160cm) x 100%

= **68.7%**

P14) After a balance was obtained between two lamps on a photometric bench, a sheet of plane glass was interposed on one side of the photometer. To restore the balance, one of the lamps was moved back through 10cm making its distance from the photometer 110 cm. What percentage of light incident on the glass was transmitted by it?

P15) A drawing office containing a number of boards having a total effective area of 70 m^2 is it by a number of 40 W incandescent lamps giving 11 l m/W. An illumination of 72 l m/m^2 is required on the drawing boards. Assuming that 60% of the total light emitted by

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the lamps is available for illuminating the drawing boards, estimate the number of lamps required.

S15) Given:

A = 70

Watt = 40

Eff = 11

E = 72

Sol`n

Op lamp = watt × eff
= (40 × 11) = 440

Flux = 0.6 × Op lamp
= (0.6 × 440) = 264

Flux total = E × A
= (72 × 700) = 5040

N = Flux Total/ Flux
= 5040/264
= 19

P16)A room with dimensions of 72 ft x 36 ft x 13 ft requires 50 footcandles, maintenance factor of 0.7,coefficient of utilization of 0.46 and RI of 4. Calculate the required lumens output of the lamps.

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P17) A 40 ft by 20 ft office is to be illuminated with duplex fluorescent luminaires at a level of 50 foot-candles. The maintenance factor coefficient of utilization are estimated to be 70% and 60%, respectively. Each fluorescent produces 3,300 lumens. How many luminaires are required?

S17) Formula:

$$MI = \frac{N \times Ø \times C.U \times M.F}{A}$$

$$N = \frac{MI \times (A)}{Ø \times C.U \times M.F}$$

$$N = \frac{50 \times (40 \times 20)}{3300 \times 0.7 \times 0.6}$$

N= 28.86 OR 28

P18) Which is not found in a rapid start fluorescent lamp?

S18) **starter**

P19) A colliery workshop 20 x 10 m requires an average Illumination of 135 lm/m^2 on the working plane. Calculate the electrical power and current required for the purpose.

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Allow a coefficient of utilization of 0.45 and a depreciation factor of 1.4. The supply is 230V at 50Hz and the efficiency of each of the lamps is 12lm/W.

S19) Given:

Area: 20 x 10m= 200m^2 Average

illumination: 135lm/m^2

Coefficient utilization: 0.45

Depreciation factor: 1.4

Supply: 230V 50Hz

Efficiency of lamps: 12lm/W

Solution:

D.F. >1 place @ denominator

D.F. <1 place @ numerator

1lamp = 12lm/W

Emaintained $= \frac{\phi NCu}{A\,df}$

135lm/m^2

Ø= 135lm/m^2 (200m^2) 1.4

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12lm/W (0.45)

Ø _____= 7000W or 7kW

For Current

P=EI

I= P = 700

E 230

= 30.43 A

P20) A drawing hall in an engineering college is to be provided with a lighting installation. The hall is 30 m x 20 m x 8 m: (high). The mounting height is 5 m and the illumination required is 135 lm/m2. Using metal lamps, estimate the size and number of single lamp luminaires. Assume

Utilization coefficient 0.6; maintenance factor (0.75

Space/height ratio = 1; lm/W for 300-W lamp 13, lm/watt for 500-W lamp 15

S20) Mounting Height is 5

Illumination Required 135 lm/m2

Utilization Coefficient 0.6

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Maintenance factor = 0.75

Space/Height Ratio = 1

(30 x 20 x 135 x 1)/.6 = 135,000

135,000/3900 = 35 For 300 Watts lamp 13

135,000/7500 = 18 For 500 Watts lamp 15

30/6 = 6

20/5 = 4

6 x 4 = 24 Lamps

Therefore, Selecting ***500W, 24 Lamps***

P1) Four lamps are suspended 8m above the ground at corners of a square of 3m side. Each lamp gives 250 candelas uniformly below the horizontal plane. Calculate the illumination at the center of the square.

S1)

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$$E_{p1} = E_{p2} = E_{p3} = E_{p4}$$

P2) A 100 candela lamp emits light uniformly in all directions and is suspended 2m Above the center of a working table which Is 3m square.Calculate the illumination at Each corner of the table. ***S2)*** $d^2=(1.5)^2+(1.5)^2+(2)^2$ $d^2=8.5$ $d=2.915$

$Ep=I / d^2 \cos \theta$

$Ep= (100/8.5) \cos(10/2.915)$

$Ep=11.77lux$

P3) A work room 33 m long by 13 m wide is illuminated by means of 10 lamps suspended 3 m above the working plane. Determine the mean spherical candle power of the lamps required to give an average illumination of 27 lm/m2 at the work table. Assume that 25% of the total light falls on the working plane.

S3)

368. 7 *candelas I*= 369 *candelas*

P4) A building 25 m long and 18 m wide is to have a minimum illumination of 56 lm/m2. Electric lamps of efficiency 10 lm/w are to be suspended 3 m above the floor, the space/height ratio being 1.2. If coefficient of utilization is 0.6 and maintenance factor is 0.8, calculate the number of fittings required and the rating of each fitting in watts.

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S4) Given.

Space/height ratio = 1.2

Area of building (l × w) = 25×18 = 450m^2

Coefficient of Utilization = 0.6

Maintenance Factor = 0.8

Minimum Illumination = 56 lm/m^2

Luminous Efficiency = 10 lm/w

Distance along the length =

Distance along the width =

Number of lamps required = 7×5=35 lamps

Gross Lumen Required= Area×minimum

illumination/CU×MF Gross Lumen Required=

450×560/.6×0.8=52500 no. of lamps= GLS / Total

Lumen; 35= 52500 / Total Lumen

Total lumen=1500

Size of lamps(Watts)= total lumen / luminous efficiency

Size of lamps Watts= 1500 / 10=150 watts

Answer (35, 150 watts)

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P5) a school classroom with general dimensions of 24 ft x 30 ft is lighted with 10 fluorescent fixtures of 4 lamps per fixture and 3,200 lumens per lamp. What is the initial illumination in foot candles assuming that coefficient of utilization is 0.35?

S5) Initial foot candle =

= 62.222222222 footcandle

P6) what is the maintained illumination assuming that maintenance factor is 0.70?

S6) 62.22x0.70 **= *43.55***

P7) A workshop measures 7 m x 13 m and is lighted by 10 lamps which are rated at 200W and have an efficiency of 15lm/W. Assuming a depreciation factor of 1.5 and a coefficient of utilization of 0.5 find the illumination on the working plane.

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S7) Given:

Area: 7m x 13m

10 lamps/200W

15 lm/W

DF= 1.5

CV=0.5

Solution:

200x15= 300 (Size of lamps x luminous efficiency= Total Lumen)

Number of lamps = GLS/Total Lumen

10= GLS/3000 = GLS 3000X10= 30000

GLS= AREA X ILLUMINATION X DF/ CV

30000= (7X13) (illumination) (1.5)/ 0.5

ILLUMINATION = 109.80 OR 110lm/m2

P8) An office, 17 m by 8 m wide, is lighted by 8 lamps and each lamp has luminous intensity of 200 Cd. Allowing an absorption loss of 4000 lm for the reflectors, walls and ceiling, calculate the average illumination on the working plane.

S8)

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P9) A 40-watt fluorescent lamp 120 centimeters long produces 3200 lumens of light in a room having a general dimensions of 10 ft x 20 ft. Find the illumination on the floor.

S9) ∅ = 3200 lumens

Area =10 x 20=200 ft^2

Foot - candle= ∅ /Area=3200/(10 x 20)=16 foot-candle

P10) find the luminance if the reflectance factor of the wall is 40%.

A. 40 footlamberts B. 102 footlamberts C. 6.4 footlamberts D.2.56 footlamberts

S10) 1 Footlambert = Footcandle x Reflectance factor

= 16 x 40% = ***6.4 footlamberts***

P11) The illumination of room is being designed. the illumination intensity is 50foot candles. the maintenance factor is 0.6. if the room is 20ft by 15ft. what is the total required lumens output of the lamp?

S11) Footcandles= 50

Mf= 70%

CU= 0.6

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Area= 300ft² Solution:

Required Light output = Footcandles x Area / (no. Of fixtures x Mf x CU)

= (50x300ft²)/(1.02x0.70x0.6)

Required Light output = ***35,014.01 lumens***

P12) A room 20 ft x 30 ft is illuminated by five 200-watt, 3700 lumen incandescent lamps. The average illumination intensity at the working plane as measured by a foot – candle meter is 10 lumens per square foot. Calculate the utilization factor of the lamps.

S12) □□□□□□= 10

Area=20 x 30=60 ft^2

Number of lamps=5

Ø=3700 lumens

$$E_{initial} = \frac{Ø \; x \; N \; x \; Cu}{A}$$

$$Cu = \frac{Einitial \; x \; A}{Ø \; x \; N} = \frac{10 \; x \; 20 \; x \; 30}{3700 \; x \; 5} = 0.32$$

P13) A twhat distance from a screen should the lamp of 120 Cd be placed to produce the same Illuminationon thes creen as a lamp of 30 Cd would give when place at a distance of 40cm From the screen?

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S13) For the illumination for the second lamp:

Formula: $Ep=I/d^2(\cos \theta)$

$Ep=30Cd / 40cm^2 (\cos 0)$

Ep = 0.01875 phot For

the first lamp:

Formula: Ep=I/d2 (cos θ)

$0.01873=120Cd/ d^2 (\cos 0) =$ ***80cm***

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