ILLUMINATION ENGINEERING
(ELEC 3241)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   Which photometer is used for comparing lights of different colours?
            (a) Flicker photometer   (b) Bunsen grease spot photometer
            (c) Luxmeter   (d) Integrating sphere

    (ii)   A lamp has a luminous flux of 1570 lumen. Its MSCP is
            (a) 125   (b) 250   (c) 392.5   (d) 785.

    (iii)   The illumination at a point on a working plane directly below the lamp is 64 lux. The lamp gives 256 CP uniformly below the horizontal plane. The mounting height is
            (a) 1.6m   (b) 2m   (c) 2.5m   (d) 2.56m.

    (iv)   The unit of exitance is
            (a) lux   (b) lumen/sqm   (c) candela   (d) steradian.

    (v)   A 200V lamp draws a current of 0.4A from the supply and emits 1500 lumen. Its luminous efficacy is
            (a) 75lm/W   (b) 37.5lm/W   (c) 18.75lm/W   (d) 17lm/W.

    (vi)   Melting point of tungsten is
            (a) 2600^0C   (b) 2800^0C   (c) 3400^0C   (d) 4400^0C.

    (vii)   Which of the following lamps is mostly not used in emergency lighting?
            (a) Incandescent lamp   (b) Compact fluorescent lamp
            (c) Fluorescent lamp   (d)High pressure mercury vapour lamp

    (viii)   Overall uniformity is the ratio of
            (a) Minimum illuminance to Maximum illuminance
            (b) Maximum illuminance to Minimum illuminance
            (c) Maximum illuminance to Average illuminance
            (d) Minimum illuminance to Average illuminance.

(ix)   If L_o is the task luminance and L_b is the background luminance, contrast is equal to

(a) $\frac{L_o - L_b}{L_b}$ (b) $\frac{L_o - L_b}{L_o}$ (c) $\frac{L_o - 2}{L_b}$ (d) $\frac{L_o - 2}{L_o}$.

(x)   In order to be able to discern the features of human face the minimum luminance (in Cd/m^2) required is

(a) 1   (b) 2   (c) 10   (d) 20.

Group – B

2.   (a)   Define the unit of luminous intensity in SI system

     (b)   Distinguish between photopic and scotopic vision.

     (c)   Determine the mid zonal intensity, zonal constant and zonal lumen of the luminaire whose luminous intensity distribution (in cd) is as follows:

Gamma	C 0°	C 45°	C 90°
5°	80	78	72
15°	74	72	66
25°	69	64	59
35°	62	57	50
45°	55	50	41
55°	48	42	32
65°	38	32	22
75°	26	20	12
85°	14	8	2

1 + 3 + 8 = 12

3.   (a)   What do you mean by V(λ) correction in luxmeter? Also explain cosine correction and how can we rectify it.

     (b)   A light source having an intensity of 400CP in all directions is fitted with a reflector so that it directs 80% of its light along a beam having a divergence of 15°. Determine the total light flux emitted along the beam. Also determine the average illumination produced on a surface normal to the beam direction at a distance of 8m.

     (c)   What do you mean by Rousseau's construction?

4 + 4 + 4 = 12

Group – C

4.   (a)   Draw the spectral power distribution curve of low pressure sodium vapour lamp. Why do we use indium oxide coating in this lamp?

     (b)   What do you mean by regenerative cycle for tungsten halogen lamp?

     (c)   State the advantages of incandescent lamps.

     (d)   What do you mean by stroboscopic effect in fluorescent lamp? How is it eliminated?

2 + 3 + 3 + 4 = 12

5. (a) Explain the principle of operation of an electronic ballast of fluorescent lamp with the help of a neat diagram.

    (b) Briefly discuss the construction and principle of operation of high pressure sodium vapour lamp with the help of a neat diagram.

    6 + 6 = 12

Group – D

6. The workshop in a factory measuring 40mX20mX8m is to be illuminated with the help of luminaires suspended 7.5m above the ground. The average illumination required on the working plane is 100lux. The working plane is 0.5m above the ground.
    (i)   Determine cavity ratios of floor, room and ceiling.
    (ii) Which type of lamp is used for the design and why?
    (iii) What is the efficacy of the lamp?
    (iv) Assuming utilisation factor of 0.5, maintenance factor of 0.6, estimate number and wattage of the lamps.
    (v)   Draw the disposition of the lamps.
    (vi) Determine space-height ratio of your design.

    (3 + 2 + 1 + 2 + 2 + 2) = 12

7. (a) Define ballast factor.

    (b) Show that the effective ceiling cavity reflectance ρ_{cc} of a hemispherical dome is given by

    $$\rho_{cc} = \frac{\rho_s}{2 - \rho_s}$$

    where ρ_s is the reflectance of the ceiling surface.

    (c) Describe different types of equipment used for emergency lighting.

    (d) The conference room in an office building is to be designed for proper illumination. Typical task consists of viewing the projection on a whiteboard.
    (i)   Select the illuminance category from table I, giving proper reason.
    (ii) Age of the workers range from 20 to 60 and reflectance of the whiteboard is 80%. Speed and accuracy of the task is mostly considered important. Select proper weighting factors from table II.
    (iii) Determine the recommended illuminance level for the area.

Table I		
Type of Activity	**Illuminance Category**	**Range of Illuminance (lux)**
Performance of visual task of high contrast or large size	D	200-300-500
Performance of visual task of medium contrast or small size	E	500-750-1000
Performance of visual task of low contrast or very small size	F	1000-1500-2000

Table II			
Task and worker	**Weighting factors**		
Characteristics	**-1**	**0**	**+1**
Worker's age	Under 40	40-55	Above 55
Reflectance of task background	Greater than 70%	30%-70%	Less than 30%
Speed and/or accuracy	Not important	Important	Critical

(1 + 2 + 5 + 4) = 12

Group – E

8. (a) What is IP code?

   (b) Explain NEMA classification system of luminaires.

   (c) Explain spread, throw and control for road lighting luminaire.

   (d) Distinguish between cut-off, semi cut-off and non cut-off luminaires. Which type is suitable for A1 category of roads?

   2 + 3 + 3 + 4 = 12

9. (a) Define beam of a luminaire.

   (b) "The level of luminance is considered a design parameter for road lighting". Justify the above statement.

   (c) What are the different types of arrangement of road lighting luminaires according to the width of the road and mounting height of the luminaires?

   (d) What do you mean by high mast lighting?

   (e) The front of a building measuring 30mX12m is to be floodlighted by means of projectors placed at a distance of 2m from the wall. The average illumination required is 50lux.
   (i) Which lamp is used for the design and why?
   (ii) Assuming waste light factor of 1.2, maintenance factor of 0.6 and coefficient of utilisation of 0.5, determine the wattage and number of projectors used.
   (iii) Determine the beam angle of the projector.

   1 + 2 + 2 + 2 + (1 + 2 + 2) = 12

Department & Section	Submission Link
EE	https://classroom.google.com/c/Mjk5MzgxMjYwMTIw/a/MzU5MzYyODAwNjM3/details