

| Table II                       |                   |           |               |
|--------------------------------|-------------------|-----------|---------------|
| Task and Worker                | Weighting Factors |           |               |
| Characteristics                | -1                | 0         | +1            |
| Workers' 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      |

- (i) Select the illuminance category from the Table I with proper reason.  
(ii) Select proper weighting factors from the Table II.  
(iii) Determine the recommended illuminance level for the task area.

(c) State and explain the design parameter of indoor general lighting scheme.

$$4 + (1+2+1) + 4 = 12$$

7. (a) A workshop measuring 60m × 15 m × 6 m is required to be illuminated by means of suitable luminaries mounted 5 m above the working plane. The average illumination required on the working plane is 150 lux. The coefficient of utilisation = 0.4. Assume a space-height ratio of unity and maintenance factor of 0.6.

- (i) Which lamp is most suitable to be used for the design and why?  
(ii) How many lamps and luminaires are required for the design?  
(iii) Estimate the wattage of the lamps.

(b) Write short notes on emergency lighting.

(c) Name the factors that contribute to the total light loss factor.

$$(2+ 2 + 1) + 4 + 3 = 12$$

### Group – E

8. (a) Distinguish between transverse, longitudinal and overall uniformity in case of road lighting.  
(b) Explain the terms related to road lighting installation with the help of a neat diagram: outreach, overhang, clearance, span and spacing.  
(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?

$$3 + 5 + 4 = 12$$

9. (a) An advertisement banner measuring 6 m × 5 m is to be floodlighted by means of projectors placed at a distance of 1 m from the banner. The average illumination required is 100 lux.

- i) Which lamp is used for the design and why?  
ii) Assuming waste light factor of 1.2, maintenance factor of 0.5 and coefficient of utilisation of 0.5, determine the number of projectors used.  
iii) Determine the beam angle of the projector.

(b) What are the photometric properties of a floodlight luminaries?

(c) What do you mean by IP rating of luminaries?

(d) If a floodlighting luminaire is designated "NEMA 6X5", what does it imply?

$$(2+2+2) + 2 + 2 + 2 = 12$$

## ILLUMINATION ENGINEERING (ELEC 3132)

Time Allotted : 3 hrs

Full Marks : 70

*Figures out of the right margin indicate full marks.*

**Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one 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 lamp has negative CRI?  
(a) Low pressure sodium vapour lamp  
(b) High pressure sodium vapour lamp  
(c) Metal halide lamp  
(d) Tungsten filament lamp.
- (ii) The code of practice for interior illumination is  
(a) IS3646 (b) IS1944 (c) BIS1981 (d) none of these.
- (iii) Which of the following has the least diameter?  
(a) T4 lamp (b) T5 lamp (c) T8 lamp (d) T12 lamp.
- (iv) The phosphor coating in a fluorescent lamp converts  
(a) ultraviolet rays to visible light (b) infrared rays to visible light  
(c) ultraviolet rays to infrared rays (d) none of these.
- (v) Which photometer is used to measure illuminance?  
(a) Luxmeter (b) Bench photometer  
(c) Integrating sphere (d) Distribution photometer.
- (vi) Which photometer is used to measure luminous flux?  
(a) Integrating sphere (b) Bench photometer  
(c) Luxmeter (d) Distribution photometer.
- (vii) Which lamp has the least starting time?  
(a) Incandescent lamp (b) High pressure sodium vapour lamp  
(c) Metal halide lamp (d) High pressure mercury vapour lamp.

- (viii) If the operating voltage of an incandescent lamp is increased, the lumen output and lamp life respectively
  - (a) increases and decreases
  - (b) increases and increases
  - (c) decreases and decreases
  - (d) decreases and increases.
- (ix) How much minimum luminance (in cd/m<sup>2</sup>) is necessary to discern the features of the human face?
  - (a) 1
  - (b) 2
  - (c) 10
  - (d) 20.
- (x) Coefficient of utilisation is the ratio of
  - (a) total lamp flux reaching the working plane to the total lamp flux
  - (b) total downward flux to the total lamp flux
  - (c) total upward flux to the total lamp flux
  - (d) none of these.

**Group – B**

- 2. (a) Distinguish between photopic and scotopic vision.
  - (b) Define luminous intensity. What is its unit in SI system?
  - (c) Briefly discuss the construction and principle of operation of a luxmeter.
- 4 + 2 + 6 = 12**
- 3. (a) Determine the mid zonal intensity, zonal constant and zonal lumen of the luminaire whose intensity (cd) distribution is as given follows:

| Gamma | C 0° | C 45° | C 90° |
|-------|------|-------|-------|
| 5°    | 60   | 60    | 60    |
| 15°   | 58   | 56    | 54    |
| 25°   | 56   | 50    | 46    |
| 35°   | 52   | 48    | 40    |
| 45°   | 48   | 42    | 32    |
| 55°   | 42   | 34    | 22    |
| 65°   | 36   | 26    | 12    |
| 75°   | 28   | 16    | 2     |
| 85°   | 20   | 6     | 0     |

Two lamps having uniform intensity of 500cd are mounted at a height of 3 m. What must be the separation in between the lamps so that the illumination on the ground, mid-way between the lamps, gets halved as the distance between the lamps gets doubled?

**9 + 3 = 12**

**Group – C**

- 4. (a) Briefly discuss the construction and principle of operation of low pressure sodium vapour lamp.
  - (b) What is stroboscopic effect and how is it eliminated for fluorescent lamps?
  - (c) State the advantages and disadvantages of compact fluorescent lamp over incandescent lamp.
- 6 + 3 + 3 = 12**
- 5. (a) Why do we use a high frequency inverter in the circuit of an electronic ballast? Draw the circuit and explain its operation.
  - (b) What do you mean by regenerative cycle for tungsten halogen lamp?
  - (c) Briefly explain the principle of operation of light emitting diode. What do you mean by internal efficacy?

**6 + 3 + 3 = 12**

**Group – D**

- 6. (a) An industrial building has sawtooth roof. The length and width of the opening of the ceiling are 100 ft and 20 ft respectively. The slant surfaces of the roof have widths of 20 ft and 11 ft. The slant surface having the width of 11 ft is made of glass having a reflectance of 10% whereas all the other surfaces have reflectance of 50%. Determine the effective ceiling cavity reflectance.
- (b) A worker, aged 62, inspects very small electronic circuit boards for any defects in etching. The boards are used in the computer in a spacecraft. The board is green with a reflectance of about 35%.

| Type of Activity                                                                       | Illuminance Category | Range of Illuminance (lux) |
|----------------------------------------------------------------------------------------|----------------------|----------------------------|
| Performance of visual tasks of high contrast or large size                             | D                    | 200 – 300 – 500            |
| Performance of visual tasks of medium contrast or small size                           | E                    | 500 – 750 – 1000           |
| Performance of visual tasks of low contrast or very small size                         | F                    | 1000 – 1500 – 2000         |
| Performance of visual tasks of low contrast or very small size over a prolonged period | G                    | 2000 – 3000 - 5000         |