

**APPLIED ILLUMINATION ENGINEERING  
(ELEC 4221)**

**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) The SI unit of luminance is  
(a) lumen                      (b) candela                      (c) lumen/sq m                      (d) candela/sq m.
- (ii) The unit of irradiance is  
(a) Watt/sqm                      (b) Watt/sr                      (c) lumen/sr                      (d) lumen/sqm.
- (iii) When the average luminance is greater than 3cd/m<sup>2</sup>, the \_\_\_\_\_ cells are active and the vision is \_\_\_\_\_.  
(a) rod, scotopic                      (b) rod, photopic  
(c) cone, scotopic                      (d) cone, photopic
- (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) infrared rays to ultraviolet rays.
- (v) Which of the following lamps gives nearly monochromatic light?  
(a) Low pressure mercury vapour lamp  
(b) High pressure mercury vapour lamp  
(c) Low pressure sodium vapour lamp  
(d) Fluorescent lamp.
- (vi) Which lamp has negative color rendering index (CRI)?  
(a) Low pressure sodium vapour lamp  
(b) High pressure sodium vapour lamp  
(c) Metal halide lamp  
(d) Tungsten filament lamp.
- (vii) Which of the following fluorescent tube lamps has the least diameter?  
(a) T8 lamp                      (b) T5 lamp                      (c) T4 lamp                      (d) T12 lamp.

- (viii) The starter used in a fluorescent lamp has which of the following functions?  
(a) Preheating of electrodes of fluorescent lamp  
(b) Supply of high voltage for ionisation of gas inside a fluorescent lamp  
(c) Regulating the current inside the fluorescent lamp  
(d) Supply of high current for ionisation of gas inside a fluorescent lamp.
- (ix) An auto transformer used with sodium vapour lamp should have  
(a) high efficiency (b) high step down ratio  
(c) high step up ratio (d) high leakage reactance.
- (x) The level of illumination on a surface least depends on  
(a) luminous intensity of the source (b) wattage rating of the source  
(c) distance of the source (d) ambient temperature.

### **Group - B**

2. (a) Define luminous intensity and luminous flux. [(CO1)(Remember/LOCQ)]  
(b) Distinguish between photopic and scotopic vision. [(CO1)(Analyze/IOCQ)]  
(c) Explain the principle of operation of contrast type Lummer Brodhun Photometer head with the help of a neat diagram. [(CO2)(Analyze/IOCQ)]  
**4 + 3 + 5 = 12**
3. (a) Discuss about the importance of cosine correction in luxmeter. [(CO2)(Analyze/IOCQ)]  
(b) The illuminance at a point on a horizontal working plane directly below the lamp is 100 lux. The lamp emits 400 cd uniformly below the horizontal plane. Determine  
(i) height at which lamp is suspended.  
(ii) illumination at a point on the working plane 1.2m away from the vertical axis of the lamp.  
(iii) illumination at a point 2m away from the vertical axis of the lamp if the intensity is reduced by 10% . [(CO1)(Evaluate/HOCQ)]  
(c) State the assumptions of Inverse Square Law of illumination. [(CO1)(Remember/LOCQ)]  
**3 + 6 + 3 = 12**

### **Group - C**

4. (a) What is the function of starter and choke used in fluorescent lamp? [(CO3)(Remember/LOCQ)]  
(b) Explain the different methods used to eliminate stroboscopic effect in fluorescent lamp. [(CO3)(Analyze/IOCQ)]  
(c) Explain the necessity of the auxiliary electrode in high pressure mercury vapour lamp. [(CO3)(Analyze/IOCQ)]  
**4 + 6 + 2 = 12**

5. (a) Describe the construction and principle of operation of high pressure sodium vapour lamp. [(CO3)(Understand/LOCQ)]  
(b) "High pressure sodium vapour lamp is not suitable for road lighting." Justify the statement. [(CO3)(Justify/HOCQ)]  
**8 + 4 = 12**

### **Group - D**

6. The workshop in a factory measuring 40 m × 20 m × 8 m is to be illuminated with the help of luminaires suspended 7.5 m above the ground. The average illumination required on the horizontal working plane is 150lux. 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 and luminaires.  
(v) Draw the disposition of the luminaires.  
(vi) Determine space-height ratio of the proposed design. [(CO4)(Evaluate/HOCQ)]  
**(3 + 2 + 1 + 2 + 2 + 2) = 12**
7. (a) Determine the effective ceiling cavity reflectance of a barrel vaulted ceiling having length of 12 m and width of 6 m and reflectances are 70% for the ceiling surfaces and 50% for the wall surfaces which are the ends of the ceiling. [(CO4)(Evaluate/HOCQ)]  
(b) Write short notes on emergency lighting design. [(CO4)(Understand/LOCQ)]  
**4 + 8 = 12**

### **Group - E**

8. (a) Distinguish between transverse, longitudinal and overall uniformity in case of road lighting. [(CO5)(Analyse/IOCQ)]  
(b) Explain the terms related to road lighting installation with the help of a neat diagram: tilt angle, overhang, clearance, span and spacing. [(CO5)(Remember/LOCQ)]  
(c) What are the different types of arrangement of road lighting poles according to the width of the road and mounting height of the luminaires? [(CO5)(Remember/LOCQ)]  
**3 + 5 + 4 = 12**
9. (a) An advertisement banner measuring 5m × 4m is to be floodlighted by means of projectors placed at a distance of 1m from the banner. The average illumination required is 100lux.  
(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. [(CO5)(Evaluate/HOCQ)]

- (b) Explain the method of using isofootcandle diagrams for calculation of average illumination level in roadlighting.

[(CO5)(Analyse/IOCQ)]

**6 + 6 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37.5	29.17	33.33

**Course Outcome (CO):**

After the completion of the course students will be able to

1. Apply laws of photometry for calculation of illuminance levels for different lighting applications
2. Understand the principles of operation of different photometers
3. Compare different types of lamps according to their specifications and uses
4. Develop energy efficient indoor lighting installations complying with lighting code
5. Correlate parameters of energy efficient outdoor lighting installations.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question