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

(ii) The unit of illuminance is
(a) lumen (b) candela/sq m
(c) lumen/steradian (d) lux.

(iii) When the luminance is less than 0.001Cd/m^2, the _____ cells are active and the vision is _____
(a) cone, photopic (b) rod, photopic
(c) cone, scotopic (d) rod, scotopic.

(iv) Which of the following lamps has the highest CRI?
(a) Low pressure sodium vapour lamp
(b) High pressure sodium vapour lamp
(c) Metal halide lamp
(d) Tungsten filament lamp.

(v) Which one of the following is responsible for the production of higher ignition voltage in a fluorescent lamp?
(a) Phosphor coating (b) Electrodes (c) Starter (d) Choke.

(vi) Which of the following has the highest diameter?
(a) T4 lamp (b) T5 lamp (c) T8 lamp (d) T12 lamp.

(vii) Fluorescent lamp operating on dc supply needs _____ in addition to a starter and a choke.
(a) both inductor and capacitor (b) capacitor
(c) inductor (d) resistor

(viii) In road lighting Threshold Increment (TI) value is a measure of
(a) transverse uniformity (b) longitudinal uniformity
(c) discomfort glare (d) disability glare.

(ix) Overall uniformity of illuminance 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.

(x) Which one of the following IP ratings denote the highest protection of the luminaire against solid particles?
(a) IP 22 (b) IP 24 (c) IP 46 (d) IP 60.

Group - B

2. (a) Define luminance and illuminance. *[(CO1)(Remember/LOCQ)]*
(b) What is mesopic vision? *[(CO1) (Remember/LOCQ)]*
(c) A lamp having an uniform intensity distribution of 150 cd in all directions is fitted with a reflector which directs 65% of the total light along a beam uniformly on a circular area of 10 m diameter. The lamp is hung 5 m above the area. Calculate
(i) the total light flux emitted along the beam
(ii) the illumination at the center without reflector
(iii) the illumination at the edge of the surface without reflector
(iv) the illumination at the center with reflector. *[(CO1)(Evaluate/HOCQ)]*

2 + 2 + 8 = 12

3. (a) Explain the principle of operation of an integrating sphere with the help of a neat diagram. *[(CO2)(Analyse/IOCQ)]*
(b) Name the different types of photometer heads used in bench photometer. *[(CO2)(Remember/LOCQ)]*
(c) Distinguish between direct, substitution and relative photometry. *[(CO2)(Understand/LOCQ)]*

7 + 2 + 3 = 12

Group - C

4. (a) Name the different types of ballast. *[(CO3)(Remember/LOCQ)]*
(b) Compare CFL and LED lamps in terms of electrical and photometric parameters. *[(CO3)(Analyse/IOCQ)]*
(c) Define colour rendering index (CRI) and correlated colour temperature (CCT). *[(CO3)(Remember/LOCQ)]*

3 + 5 + 4 = 12

5. (a) What do you mean by regenerative cycle for tungsten halogen lamp? *[(CO3)(Understand/LOCQ)]*
(b) Distinguish between thermal and glow starters used in fluorescent lamp. *[(CO3)(Understand/LOCQ)]*

(c) Draw the spectral power density curve of low pressure sodium vapour lamp. Why indium oxide coating is done on the inside of the outer envelope for low pressure sodium vapour lamp? *[(CO3)(Remember/LOCQ)]*

4 + 5 + 3 = 12

Group - D

6. (a) Compare watts per square meter method and lumen method of indoor lighting design. *[(CO4)(Analyse/IOCQ)]*

(b) A workshop measuring 60 m × 15 m × 6 m is required to be illuminated by means of suitable luminaires mounted 5 m above the working plane. The average illumination required on the working plane is 150 lux. The coefficients of utilization = 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) What is the efficacy of the lamp?
(iii) How many lamps and luminaires are required for the design?
(iv) Estimate the wattage of the lamps.
(v) Draw the disposition of the luminaires. *[(CO4)(Evaluate/HOCQ)]*

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

7. (a) Name the design parameters of indoor lighting. *[(CO4)(Understand/LOCQ)]*

(b) The inspection room of printed circuit board in an electronic equipment manufacturing company is to be designed for proper illumination. Typical task consists of working on the computer. Age of the workers range from 30 to 50 and reflectance of the task background is 60%. Speed and accuracy of the task is mostly considered important.

(i) Select the illuminance category from Table I, giving proper reason.

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

(ii) Select proper weighting factors from Table II.

Table II

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

(iii) Determine the recommended illuminance level for the area.

[(CO4)(Evaluate/HOCQ)]

(c) Name the classifications of hazardous locations as listed by the National Electrical Code. *[(CO4)(Remember/LOCQ)]*

3 + 6 + 3 = 12

Group - E

8. (a) What is IP code? *[(CO5)(Remember/LOCQ)]*
   (b) Explain NEMA classification system of floodlight luminaires. *[(CO5)(Understand/LOCQ)]*
   (c) Explain spread, throw and control for road lighting luminaire. *[(CO5)(Remember/LOCQ)]*
   (d) Distinguish between cut-off, semi cut-off and non cut-off luminaires. Which type is suitable for A1 category of roads? *[(CO5)(Analyse/IOCQ)]*

2 + 3 + 3 + 4 = 12

9. (a) Which parameter is used to improve the spread of light for a road lighting luminaire and why? *[(CO5)(Analyse/IOCQ)]*
   (b) Explain why we should consider the level of luminance as a design parameter for road lighting. *[(CO5)(Analyse/IOCQ)]*
   (c) Write short notes on high mast lighting. *[(CO5)(Understand/LOCQ)]*

3 + 3 + 6 = 12

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*50*	*27*	*23*

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.*