B.TECH/EE/5TH SEM/ELEC 3132/2018 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 <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: $10 \times 1 = 10$
 - (i) Which of the following lamps give nearly monochromatic light?
 (a) Low pressure Sodium vapor lamp
 (b) GLS lamp
 - (c) Fluorescent Tube light
 - (d) Mercury vapor lamp.
 - (ii) Light is produced in electric discharge lamps by
 (a) heating effect of current
 (b) magnetic effect of current
 (c) ionization in a gas or vapor
 (d) carbon electrodes.
 - (iii) Power factor is highest in case of

 (a) mercury arc lamp
 (b) sodium vapor lamps
 (c) fluorescent lamp
 (d) GLS lamps.
 - (iv) One lumen per square meter is the same as
 (a) one lux
 (b) one candela
 (c) one foot candle
 (d) one lumen meter.
 - (v) Fluorescent lamp operating on dc supply needs which element in addition to a starter and a choke.
 (a) resistor
 (b) capacitor
 - (c) inductor (d) both inductor and capacitor.
 - (vi) Luminous efficacy of a fluorescent tube lamp is

 (a) 5 10 lumens/watt
 (b) 15 20 lumens/watt
 (c) 30 40 lumens/watt
 (d) 60 65 lumens/watt.
 - (vii) Which photometer is used for comparing the lights of different colors?
 (a) Bunsen photometer
 (b) Grease spot photometer
 (c) Lummer Brodhun photometer
 (d) Flicker photometer.

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viii)	The output of a tungsten filament lamp depends on		
	(a) size of lamp	(b) size of shell	
	(c) temperature of filament	(d) all of the above.	

- (ix) Which of the following electric discharge lamps gives highest lumens/watt?
 (a) Low pressure sodium vapor
 (b) Low pressure mercury vapor
 (c) High pressure sodium vapor
 (d) High pressure mercury vapour.
 (x) A lamp has a total luminous flux of 1570 lumens. Its mean spherical
- luminous intensity (MSLI) is (a) 125 (b) 250 (c) 200 (d) 500.

Group – B

- 2. (a) What is photopic vision? Draw the visual response curve of standard observer for photopic vision. What can you infer from this curve?
 - (b) Is luminance a fundamental physical quantity? If not, derive its unit in SI system.
 - (c) Distinguish between illuminance and luminous existence.
 - (d) A light source having an intensity of 400cd in all directions is fitted with a reflector so that it directs 70% 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.

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

- 3. (a) What do you mean by $V(\lambda)$ correction in luxmeter?
- (b) Show that the illuminance received at any position on the inner surface of the integrating sphere from any point lying on the surface is independent of the position of the points on the inner surface.
- (c) Determine the mid zonal intensity, zonal constant and zonal lumen of the luminaire whose intensity(cd) distribution is as follows:

Gamma	C 0°	C 45°	C 90°
5°	471	479	487
15°	359	374	441
25°	239	268	373
35°	180	178	292
45°	118	121	208
55°	49	68	120
65°	7	22	46
75°	4	8	12
85°	2	3	2

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Group – C

- Show that the diameter of the filament of an incandescent lamp is 4.(a) proportional to $I^{3/2}$, where I is the current passing through the filament.
- Discuss the advantages and disadvantages of compact fluorescent lamp. (b)
- Draw the spectral power density curve of low pressure sodium vapour (c) lamp. Why indium oxide coating is done on the inside of the outer envelope for low pressure sodium vapour lamp?
- Why do we use an auxiliary electrode in high pressure mercury vapour (d) lamp?

3 + 4 + 1 + 2 + 2 = 12

- 5. (a) Explain the principle of operation of electronic ballast of fluorescent lamp with the help of a neat circuit diagram.
- A 220V, 80W fluorescent lamp is connected in series with a magnetic choke. (b) The circuit operates at a lagging power factor of 0.7. Determine the value of the capacitance to be used to correct the power factor to unity.

Group – D

- 6. (a) A barrel vaulted ceiling measures $15m \times 6m$. The reflectances of the ceiling and wall surfaces are 80% and 50% respectively. Determine the effective ceiling cavity reflectance.
- (b) The general workspace in an office is to be designed for proper illumination. Typical task consists of working on the computer.

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

i) Select the illuminance category from the above table, giving proper reason. Age of the workers range from 20 to 60 and reflectance of the task background is 60%. Speed and accuracy of the task is mostly considered important.

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	

ii) Select proper weighting factors from the above table. iii) Determine the recommended illuminance level for the area.

Explain the Watts per square metre method of indoor lighting design. (c)

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

- 7. A lecture hall measuring $18m \times 9m \times 4.2m$ has ceiling, wall and floor reflectances 80%, 30% and 10% respectively. The luminaire is suspended 1.2m from the ceiling and the working plane is 0.6m above the floor.
 - (i) Determine the cavity ratios for the floor, room and ceiling.
 - (ii) Determine effective floor and ceiling cavity reflectances.
 - (iii) Which lamp can be used for the design and why?
 - (iv) Determine the coefficient of utilisation. (Use the tables provided in attached sheet Table 1a,b, 2 and 3)
 - (v) Assuming a maintenance factor of 0.85, determine the number of lamps and luminaires required to achieve an average illumination of 300 lux.
 - (vi) Draw the disposition of the luminaires.

3+2+2+1+1+3=12

Group - E

- 8. (a) "The level of luminance is considered a design parameter for roadlighting". Justify the above statement.
- Explain spread, throw and control for a roadlighting luminaire. (b)
- What will the IP rating be for luminaire used for underwater lighting in a (c) swimming pool?
- What are isofootcandle diagrams? How are they used in roadlighting (d) calculations?

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

- 9. (a) If a floodlighting luminaire is designated "NEMA 7X6", what does it imply?
- How do we classify projectors according to their beam spread? (b)
- The front of a building measuring $40m \times 15m$ is to be floodlighted by means (c) of projectors placed at a distance of 1m 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 number of projectors used.

(iii) Determine the beam angle of the projector.

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