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# MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
*(A constituent unit of MAHE, Manipal)*

## VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

## MAKE-UP EXAMINATIONS, JUNE 2019

## SUBJECT: LIGHTING SCIENCE DEVICES AND SYSTEMS [ELE 4007]

REVISED CREDIT SYSTEM

**Time: 3 Hours** **Date: 14, June 2019** **Max. Marks: 50**

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

**1A.** Explain the following items related to Lighting Science.

i. Radiometry and Photometry
ii. Spectral eye sensitivity curve and types of visions
iii. One light watt
iv. Corelated Colour Temperature (CCT); Warm White and Cool White CCT representation. ***(07)***

**1B.** Explain the working principle of Tungsten halogen lamp. Mention the performance characteristics/properties of Tungsten halogen lamp. ***(03)***

**2A.** A corridor, 40m long and 4m wide is lit by 5 lamps each of 500Cd, spaced 10m apart. The lamps are suspended at height of 4m from the floor above the center line of the corridor.

I. Find the illuminance below the centre lamp.
II. Find the minimum illuminance in the corridor ***(05)***

**2B.** The photometric test data of a luminaire having a lamp of nominal flux 6220 lm is given below. Determine the total lumen output, LOR, DLOR and ULOR using Zonal Integration method.

| Angle degrees | Luminous Intensity (lm) | | Angle degrees | Luminous Intensity (lm) | | Angle degrees | Luminous Intensity (lm) |
|---|---|---|---|---|---|---|---|
| 0 | 1412 | | 70 | 286 | | 140 | 86 |
| 10 | 1366 | | 80 | 156 | | 150 | 64 |
| 20 | 1340 | | 90 | 114 | | 160 | 56 |
| 30 | 1230 | | 100 | 138 | | 170 | 42 |
| 40 | 1088 | | 110 | 114 | | 180 | 36 |
| 50 | 786 | | 120 | 98 | | | |
| 60 | 444 | | 130 | 94 | | | |

***(05)***

**3A.** Explain Binning with respect to Light Emitting Diodes and the requirement for binning in LEDs. Explain different types of binning for LEDs. ***(03)***

**3B.** A room measuring 18m × 9m is to be lit to a lighting level of 150 lux. Height of the room is 4.5m and work plane is 80cm above the floor level. The luminaires are to be ceiling mounted and house reflector lamps having L.D.L of 4500 lm. The light loss factor is 0.7. Design and validate the complete lighting scheme. Also estimate the initial glare index for the length wise direction of view. The following tables may be made use of in determining the utilization factor and Glare Index.

| RI | CU |
|---|---|
| 1.0 | 0.43 |
| 1.25 | 0.48 |
| 1.5 | 0.53 |
| 2.0 | 0.58 |
| 2.5 | 0.63 |

| ROOM DIMENSIONS | | GI |
|---|---|---|
| X | Y | |
| 2H | 4H | 14.9 |
| 3H | 4H | 15.5 |
| 2H | 6H | 15.5 |
| 3H | 6H | 15.9 |

***(07)***

**4A.** Compute the number of LEDs required for generating white light using Red-Green-Blue LEDs to achieve the design specifications of Lumen output = 400 lumens; CCT = 5000K; x = 0.3451; y = 0.3516 The LED specifications is shown in the table below. Also verify the resulting selection of number of LEDs by computing x, y coordinates to match the design specification. Compute the power of the LED luminaire of the final design.

| Edixeon RGB LED | Wavelength (nm) | Coordinate x | Coordinate y | Forward Voltage (V) | Forward Current (mA) | Luminous Flux (lm) |
|---|---|---|---|---|---|---|
| RED | 625 | 0.7006 | 0.2993 | 2.2 | 350 | 38 |
| GREEN | 528 | 0.1763 | 0.7228 | 3.4 | 350 | 65 |
| BLUE | 464 | 0.1512 | 0.0336 | 3.4 | 350 | 17 |

***(05)***

**4B.** Design a lighting control system for an office-room of size 5m X 4m X 3m with help of wiring diagram of room with two windows on one of long side wall and a door on other long side wall. Develop a best control strategy with occupancy sensors, time scheduling and daylight harvesting. Show the positioning of the lights, sensors and controllers in the wiring drawings of the room with reasoning. Also recommend features and settings of the control strategy with an example case study. ***(05)***

**5A.** Explain the following with respect to a LED luminaire.

i. Junction Temperature of LEDs and requirement of heat-sink
ii. LED arrangement in luminaire and LED luminaire driver technology
iii. Reliability estimation standards of single LED ***(06)***

**5B.** What are control zones with respect to Lighting control system? Explain any three control strategies aimed to address energy management and sustainability needs for an application. ***(04)***