



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

### END SEMESTER EXAMINATIONS, APRIL / MAY 2019

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

REVISED CREDIT SYSTEM

Time: 3 Hours

Date: 30, April 2019

Max. Marks: 50

#### Instructions to Candidates:

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

**1A.** What are “black body radiators”? Explain with the help of spectral energy distribution curves. (03)

**1B.** Draw and explain the VI characteristics of a low-pressure gas discharge lamp (03)

**1C.** Explain the following basic quantities of light and mention their units.

- i. Luminous Flux
- ii. Luminous Intensity
- iii. Illuminance
- iv. Luminance

(04)

**2A.** A room measuring 5mX4mX3m is with a 150cd lamp hung at the center of room. Assuming the lamp-light to be uniform in all directions and the lamp is suspended with height of 0.5m from the ceiling, calculate the illuminance due to lamp alone at all 4 bottom corners of the room on the horizontal plane of the floor. Also calculate the illuminance directly below the lamp and at point midway of the wall on the floor. (05)

**2B.** Compute the number of LEDs required for generating white light using Red-Green-Blue LEDs to achieve the design specifications of Lumen output = 500 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)

**3A.** With the help of neat system diagram, Explain the working principle of Fluorescent lamp. What are starters and ballasts for a Fluorescent lamp? Explain their working and significance. (03)

- 3B.** Mention and Explain the types of light distribution based on light above and below the horizontal plane with practical application examples. (03)
- 3C.** What are rated life B50 and rated lumen maintenance life L70 for LED luminaire? What are LM-80 and TM-21 standards with respect to reliability of LEDs? Explain the procedure of LM-80 and TM-21 standards for LED life testing. (04)

- 4A.** A room measuring 18m x 9m is to be lit to a lighting level of 300lux. Height of the room is 4.5m and the luminaires are to be ceiling mounted. The maintenance factor is 0.8. Design and suggest the best energy efficient lighting scheme using the available lamps.  $S_{max} / H_m$  to be 1.3. Justify the answer in terms of Light power density. Show the disposition of the selected scheme.

Available lamps are:

FTL T5 - 35Watts, 105 lm/W;

CFL - 36Watts, 80 lm/W;

LED - 28Watts, 80 lm/W.

Room index	Co-eff. of utilization
1.25	0.48
1.5	0.53
2.0	0.58
2.5	0.63

(05)

- 4B.** Design a lighting control system for a classroom of size 10m X 6m X 2.7m 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 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 any six major sensor characteristics required to match the sensor for lighting control in any application. (03)

- 5B.** What is daylight harvesting? Mention and explain the advantage and disadvantage of daylight harvesting? Explain daylight control with help of an example. (03)

- 5C.** The photometric test data of a 4-lamp fluorescent luminaire is given in Table 1. The fluorescent lamps are of 1555lm and 40 W each with ballast for entire luminaire as 10W. Find the total luminous flux using zonal integration method taking 10-degree zones. Compute the zonal lumen summary in the format shown in Table 2.

Table 1: photometric test data			
Angle	Intensity lm	Angle	Intensity lm
5	1389	95	126
15	1353	105	126
25	1285	115	106
35	1159	125	96
45	937	135	90
55	615	145	75
65	365	155	60
75	221	165	49
85	135	175	39

Table 2: zonal lumen summary	
Luminaire efficacy:	
Zones 0-90 lumens:	
Zones 90-180 lumens:	
Total Lumen:	
Light output ratio (LOR):	
Downward LOR:	
Upward LOR:	
Flux fraction ratio:	

(04)