Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent Institution of MAHE, Manipal)

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

## **END SEMESTER EXAMINATIONS, NOVEMBER 2018**

## SUBJECT: SOLID STATE LIGHTING AND CONTROL [ELE 4027]

REVISED CREDIT SYSTEM

Time: 3 Hours		Date: 29 November 2018	Max. Mark	s: 50			
Instru	Instructions to Candidates:						
	✤ Answer ALL the questions	5.					
	<ul> <li>Missing data may be suita</li> </ul>	bly assumed.					
1A.	With the help of a geometrical escape from a semiconductor h	model, derive the expression for the amount of linearing high refractive index.	ight that can	(05)			
1B.	With the help of shockley equa wavelength of multicolor LEDs	ation, explain the electrical parameters which chan	racterize the	(02)			
1C.	Explain the various stages in th light.	e life of a photon from its formation till its availabil	lity as visible	(03)			
2A.	Explain briefly the various LE improving the extraction efficient	ED shapes where light escape cone play a signifiency of LEDs	icant role in	(03)			
2B.	Explain the following termino expressions and units	logies and the relation between them in brief v	vith suitable				
	<ul><li>(a) Illuminance</li><li>(b) Luminous intensity</li></ul>			(04)			
2C.	Find the optical power of a w complementary colours having	hite light source at 550nm with CCT of 5500K r g the following specifications.	nade from 2				

Parameters	LED1	LED2
FWHM	20nm	30nm
Peak wavelength	450nm	630nm
Radiant flux	2W	1W

- (03)
- **3A.** A set of RGB LEDs having the following x and y coordinates are mixed in the proportion given below to produce a CCT of 4000K. The total lumen obtained is 250 lm. Find the lumen proportion of each colour LED present in the mixed color and also the coordinates of the mixed colour.

	x coordinate	y coordinate	Mixing proportion (lm)
Red	0.7006	0.2993	60
Green	0.1763	0.7228	175.8
Blue	0.1512	0.0336	14.4

(04)

- **3B** Define FWHM. With necessary expressions explain how the efficacy of radiation varies with FWHM for dichromatic and trichomatic LEDs.
- **3C** Define strokes shift loss. Explain the method of white light generation where this loss is significant. Also mention the other disadvantages and advantages of this method. *(04)*
- **4A.** Consider a tunable white LED luminaire consisting of RGB LEDs. The LEDs are mixed in lumen proportion in the ratio of 4:8:12. The total no. of LEDs required to obtain the desired lumen output and color temperature from LED luminaire is 64. Design a suitable power management scheme to drive the green and blue LEDs in the luminaire.

Input voltage - (50-100)V

LED specification: typical Vf = 3.4V @ 500mA

Ripple current - 20 %

Ripple voltage – 10%

Switching frequency – 40kHz

- **4B.** Describe the principle of operation of AC LEDs. Also explain the disadvantages of AC LEDs which restrict their wide usage in LED Lighting *(03)*
- **4C.** Briefly explain the reasons for driving the LEDs with switch mode supply. *(02)*
- **5A.** Explain the following with neat block diagrams.
  - (a) Phase control and AC voltage control dimmers
  - (b) Analog (0-10)V dimmers
- **5B.** Design a downlight using a single LED, which provides the highest light output at 700mA. LED must be able to produce 70% light upto 50000Hrs. Consider Rth(j-a) = 50°C/Watt. Recommend best LED for the application and justify the recommendation. Also give reasons to rule out other LEDs from recommendation. Consider the ambient temperature as 25°C.

Manufacturer	Lumen output	Drive current	NFR for 700mA	Max Tj(∘C)	L70 details	Vf at 700mA
MFR 1	85lm	350mA	1.80	145	Tj ≤ 130°C,If = 350mA	3.15
MFR 2	100lm	350mA	1.75	150	Tj ≤ 130°C,If = 350mA	2.95
MFR 3	135lm	700mA	1.00	135	Tj ≤ 125°C,If = 350mA	3.30
MFR 4	90lm	350mA	1.70	150	Tj ≤ 135°C,If = 700mA	3.00

**5C.** Explain the forward voltage method of estimating the junction temperature of LEDs

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(03)

(02)

(02)

(05)

(05)