Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent Institution of MAHE, Manipal)

II SEMESTER M.TECH (ESM / PED)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: SOLID STATE LIGHTING AND CONTROLS [ELE 5240]

REVISED CREDIT SYSTEM

Time	: 3 Hours	Date:	23 April 2018		Max. Mark	s: 50
Instru	actions to Candidates	:				
	✤ Answer ALL the	questions.				
	 Missing data may 	y be suitably assumed	ł.			
1A.	Determine an express the power escaped fr	sion for radiation patt om the semiconducto	ern of LED using g r is same as the po	geometrical model ar ower radiated into th	nd show that ne air.	(05)
1B.	Explain how resonant LEDs	cavity LEDs and pyra	amidal reflectors i	mprove the external	efficiency of	(05)
2A.	List the methods for w determining the quali	vhite light generation ity of white light.	. Explain the facto	rs that need to be co	nsidered for	(03)
2B.	For the design of an RGB LED luminaire, producing a CCT of 5000K and lumen output of 400 lumens, determine the mixing proportions using an appropriate algorithm					
	Туре	x coordinate	y coordinate	Luminous flux		

Туре	x coordinate	y coordinate	Luminous flux
Red	0.7006	0.2993	38
Green	0.1763	0.7228	65
Blue	0.1512	0.0336	17
5000K	0.3451	0.3516	-

(05)

(02)

- **2C** A down lighter consisting of 5 series connected LEDs, is operated at a typical current of 100mA with a typical forward voltage of 2.5V. The resistors are defined for a worst case supply voltage of 25V. Find the values of resistance and power loss. Also find LED operating current if the supply voltage drops by 5V.
- 3A. Design a suitable driver circuit for the luminaire specifications given below
 - Input voltage 25V to 32V
 - LED string voltage 45V to 75V
 - LED drive current 350mA
 - Ripple current $\pm 10\%$
 - LED string resistance 18ohms
 - Desired efficiency 90%
 - Change in LED drive current 15%
 - Switching frequency 30kHz

Draw the desired circuit diagram and label the values.

(05)

- With respect to LED model and its characteristics explain why LED is current driven device 3B. and a constant voltage load.
- **3C**. Briefly explain the reasons for driving the LEDs with switch mode supply.
- With neat block diagrams explain the feedback schemes used to control CCT and flux 4A. (05) variations in the luminaire.
- 4B. 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(i-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 35°C.

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

- **4C.** Mention any two methods of measuring the junction temperature of LEDs
- 5A. Explain the long term effects of temperature on the optical and mechanical parts of an LED luminaire. (02)
- What is lumen maintenance? Explain the mathematical algorithm given by TM 21 for 5B. extrapolating the data of LM 80.
- **5C**. Mention the rules that must be followed for providing a good internal and external thermal design for a luminaire.

(05)

(03)

(02)

(03)

(02)

(03)