Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, MAY 2018

SUBJECT: SOLID STATE LIGHTING & CONTROLS [ELE 4027]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 05 MAY 2018** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** questions.
- Missing data may be suitable assumed.

1A. For buck boost converter based LED driver topology give the following i) power stage transfer function for current mode control ii) Type II compensator transfer function and circuit schematic iii) procedure for compensator design. ***(08)***

1B. Explain slope compensation for current mode control with neat diagrams ***(02)***

2A. Prove from fundamentals that light power escape from the LED structure is identical to the light power in air. ***(04)***

2B. Explain the role of extraction efficiency of LED luminaire and mention the methods to improve it. What is meant by life cycle of photon? ***(04)***

2C. The Refractive index of GaAs, GaN and light emitting polymers are 3.4, 2.5 and 1.5 respectively. Calculate the critical angle of Total internal reflection (TIR) for GaAs, GaN and for polymers. ***(02)***

3A. Three LED samples with color chromaticity coordinates and lumen output specifications are given in table 1. Obtain the color chromaticity coordinates and lumen output of light mixing without dimming.

Table 1. LED sample specifications

LED	x	y	Y(ϕ)lm
1	0.42	0.385	87
2	0.46	0.395	74
3	0.475	0.425	74

(04)

3B. Explain the following i) Binning ii) Mc Adam Ellipse highlighting its significance on color mixing and white light generation. ***(04)***

3C. Discuss design factors of heat sink ***(02)***

4A. RGB color mixing is applied to get the white point chromaticity coordinates x=0.35 and y=0.33. RGB LED samples chromaticity coordinates are given in Table 2. Determine the percentage duty cycle for RGB LEDs to obtain the desired white point.

Table 2. chromaticity coordinates

LED	x	y
R	0.6763	0.3237
G	0.2088	0.7408
B	0.1405	0.0391

(04)

4B. Describe the features of DALI for solid state lighting controls. ***(02)***

4C. Explain the color stability compensation of RGB LED luminaire with a neat block diagram. ***(04)***

5A. Calculate the number of LEDs required for the design of a luminaire with light output 2000lm with optical efficiency 90% and thermal efficiency 85%. Use LEDs at 5000K CCT with minimum luminous flux of 122lm @350mA. ***(03)***

5B. A fixture with 5 LEDs connected in parallel is to be used for designing general lighting luminaire with proper heat management technique. Determine the thermal resistance specification from heat sink to air to ensure maximum ambient and junction temperature of 50˚C and 140˚C. Given LED data Vf = 3.3V, If = 350mA, Rth(Tj-sp) = 7˚C/W and Rth(sp-hs) = 1˚C/W. ***(04)***

5C. Explain pulse width modulation dimming of LED luminaires. ***(03)***