



VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKE UP EXAMINATIONS, DECEMBER 2018

SUBJECT: SOLID STATE LIGHTING AND CONTROLS [ELE 4027]

REVISED CREDIT SYSTEM

Time: 3 Hours

Date: 31 December 2018

Max. Marks: 50

Instructions to Candidates:

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

- 1A** Derive the expression for intensity emission pattern of LED and hence show that the escaped light power depends on the refractive index of the material used. **(05)**
- 1B** Explain the internal and external efficiency of LEDs with expressions **(05)**
- 2A** Explain how light extraction is improved using “surface plasmon” LEDs. **(03)**
- 2B** The refractive indices of GaAs, GaN and light emitting polymers are 3.4, 2.5, and 1.5 respectively. Calculate the fraction of light power that can escape from planar GaAs and GaN semiconductor structures and a polymer LED structure. What improvement can be attained if a planar GaAs LED is encapsulated in a transparent polymer of refractive index 1.5, if the reflection at the polymer air interface is neglected? **(04)**
- 2C** Explain the difference between color temperature and correlated color temperature of a light source **(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

(05)

- 3B** Explain the techniques for generation of white light with LEDs with their advantages and disadvantages. **(05)**
- 4A** What is the significance of current regulation in LEDs. Explain with neat diagrams the following methods of current regulation **(05)**
- (a) Resistor (b) LM317 (c) MOSFET

- 4B** Design a suitable driver topology for an LED luminaire consisting of 60 LEDs for the following specifications
- Input voltage – (90-100)V
- LED current ripple – 40%
- LED voltage ripple – 2%
- Switching frequency – 50kHz
- LED drive current – 350mA
- Typical V_f – 3.3V (05)
- 5A** Explain the various configuration schemes used for connecting multiple LEDs (04)
- 5B** What is the need for feedback control of LEDs? Explain combined temperature feed forward and flux feedback scheme to achieve color stability. (03)
- 5C** A fixture with 5 LEDs connected in parallel is to be designed for general lighting scheme with proper heat management technique. Determine the thermal resistance specification from heat sink to air to ensure maximum ambient and junction temperature of 55°C and 145°C. Given LED data $V_f = 3.25V$, $I_f = 350mA$, $R_{th}(T_j-sp) = 8^\circ C/W$ and $R_{th}(sp-hs) = 1^\circ C/W$ (03)