Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH
(ENERGY SYSTEMS & MANAGEMENT / POWER ELECTRONICS & DRIVES)
END SEMESTER EXAMINATIONS, APRIL/ MAY 2019
SUBJECT: SOLID STATE LIGHTING AND CONTROLS [ELE 5240]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 29 April 2019** **Max. Marks: 50**

Instructions to Candidates:

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

1A. Using geometrical model, derive the expression for light power that can escape from an escape cone of a semiconductor. Also calculate the fraction of light power that can escape from a planar GaAs structure with refractive index of 3.4. ***(05)***

1B. List the advantages of LEDs over conventional light sources. Also explain the major steps involved in the life of photons emitted from LEDs. ***(05)***

2A. Define color matching functions. With suitable expressions, explain the significance of these functions in determining the photometric characteristics of a light source. ***(03)***

2B. Differentiate the following:

a) CRI and CQS
b) Colour temperature and correlated colour temperature ***(05)***

2C A 100W LED lamp radiates a spectral power of 234mW @ 500nm and 433mW @ 575nm.The spectral response values at the specified wavelengths are 0.3230 and 0.9154 respectively. Calculate efficacy and LER for the lamp. ***(02)***

3A. Explain the advantages of producing white light using narrow band LEDs and phosphor coated LEDs. ***(03)***

3B. For the design of an RGB LED luminaire, producing a CCT of 5000K and lumen output of 400 lumens, determine the Tristimulus values and quantity of red, green and blue LEDs required.

Type	x coordinate	y coordinate	Luminous flux
Red	0.7006	0.2993	39
Green	0.1763	0.7228	86
Blue	0.1512	0.0336	17
4500K	0.3608	0.3636	-

(05)

3C. Explain CCT binning ***(02)***

4A. Differentiate the phase control dimmer and analog (0-10)V dimmer with their operation and advantages ***(05)***

4B. In a RGB based white light generation scheme, the mixing of lumen proportion is in the ratio of 1:5:7. The total no. of LEDs required to obtain the desired lumen output and color temperature from this fixture is 24. The fixture is to be operated from a DC voltage which is derived from 230 AC supply having 230/12V transformer and then the full wave rectifier circuit. Design a suitable power management scheme to drive the blue LEDs in the fixture.

- Typical voltage of LEDs: 3V @ 350 mA
- Dynamic resistance of LED : 9Ω
- LED current ripple – 20%
- LED voltage ripple: 10%
- Switching frequency – 30 kHz ***(03)***

4C. Mention any two methods of measuring the junction temperature of LEDs ***(02)***

5A. What is the need for feedback control of LEDs? Explain combined temperature feed forward and flux feedback scheme to achieve colour stability. ***(03)***

5B. What is lumen maintenance? Explain the mathematical steps involved in extrapolating the data of LM 80. ***(05)***

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 $55^{o}C$ and $145^{o}C$. Given LED data Vf = 3.25V, If = 350mA , Rth(Tj-sp) = $8^{o}C/W$ and Rth(sp-hs) = $1^{o}C/W$ ***(02)***