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Question Paper Code : 20399

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Sixth/Seventh Semester

Electronics and Communication Engineering

EC 6016 — OPTO ELECTRONIC DEVICES

(Common to Medical Electronics)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a unit cell?

2. List down any two applications of Hall effect.

3. What is meant by cathodoluminescence?

4. List down any four advantages of LED over lasers.

5. What is an avalanche photodiode?

6. Define conversion efficiency of a solar cell.

7. Calculate the quantum efficiency of photodiode with a responsivity of 0.7 A/W which detects 1.5 μm photo excitation.

8. Compare the two classes of switching and logic devices.

9. Give examples of active guided wave devices.

10. Define the two parameters that define the eye diagram.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Describe the BCC unit cell and hence determine the packing fraction. (6)

(ii) Describe the Hall setup to determine the majority carrier parameters. (7)

Or

(b) (i) Use Boltzmann and Joyce – Dixon approximations to estimate the error in calculating the position of Fermi level at 300°K in GaAs with $n = 2 \times 10^{17} cm^{-3}$. $N_C = 4.4 \times 10^{17} cm^{-3}$. (6)

(ii) Describe in brief Liquid Phase Epitaxy growth process. (7)

12. (a) (i) Develop notes on Franz – Keldysh effect. (6)

(ii) Describe the conduction processes in semiconductors and derive the expression for total current density. (7)

Or

(b) (i) Describe Einstein's theory of stimulated emission and hence derive the expressions for A and B coefficients. (7)

(ii) Determine the number of modes of an AlGaAs layer supported by the gain spectrum which has a bandwidth of 6 nm. The laser has a cavity length of 200 μm and the peak emission wavelength is 800 nm. Assume $n_r = 3.3$. (6)

13. (a) Derive an expression for the gain of a photoconductor with dc excitation if the device in case of both the contacts are ohmic. (13)

Or

(b) Consider an Si solar cell at 300 K. Calculate the open circuit voltage of the solar cell using the parameters. Area = 1 cm^2, Acceptor doping $N_a = 5 \times 10^{17}$ cm^{-3}, Donor doping $N_d = 10^{16}$ cm^{-3}, Electron diffusion coefficient $D_n = 20$ cm^2/s, Hole diffusion coefficient $D_p = 20$ cm^2/s, Electron recombination time $\tau_n = 5 \times 10^{-7}$s, Hole recombination time $\tau_p = 10^{-7}$s, Photocurrent $I_L = 25$ mA. (13)

14. (a) Describe an Electro – optic phase modulator with neat diagram and hence arrive at the expression for the phase difference at the output plane. (13)

Or

(b) With the circuit diagram of thresholding gate with three controllers and a modulator, discuss the output characteristics and the truth table. (13)

15. (a) Describe a monolithically integrated front end photo receiver. Also with neat sketches, explain the measurement of the eye diagram of the photo receiver. (13)

Or

(b) Describe about the Mach-Zehnder interferometer with input and output 3-dB couplers and arrive at the expression for half wave voltage. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Develop notes on the need for hybrid and monolithic integration. (15)

Or

(b) Examine the effectiveness of integrated Transmitters and Receivers. (8 + 7)

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