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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

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. State Bragg's law.
2. List down any two applications of Hall effect.
3. Find the ratio of the spontaneous to stimulated emission rates in a tungsten lamp that radiates at an average frequency of 5×10^{14} Hz at an operating temperature of 1300 K.
4. List down any four advantages of LED over lasers.
5. Define the gain-bandwidth product of the photoconductive detector.
6. Define conversion efficiency of a solar cell.
7. Calculate the quantum efficiency of an avalanche 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. What is meant by opto electronic integrated circuits ?
10. Define eye closure and jitter.

PART – B **(5×16=80 Marks)**

11. a) i) Describe the BCC unit cell and hence determine the packing fraction. **(8)**

ii) Explain the Hall set up to determine the majority carrier parameters. **(8)**

(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. **(10)**

12. a) i) Discuss on Franz-Keldysh effect. **(6)**

ii) Describe the conduction processes in semiconductors and derive the expression for total current density. **(10)**

(OR)

b) i) Describe Einstein's theory of stimulated emission and hence derive the expressions for A and B coefficients. **(8)**

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 $n_r = 3.3$. **(8)**

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. **(16)**

(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. **(16)**

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. **(16)**

(OR)

b) With the circuit diagram of thresholding gate with three controllers and a modulator, discuss the output characteristics and the truth table. **(16)**

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. **(16)**

(OR)

b) With a neat diagram, describe about the Mach-Zehnder interferometer with input and output 3-dB couplers and arrive at the expression for half wave voltage. **(16)**

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