Reg. No.: 21BEC1603

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Continuous Assessment Test II

Programme	: B.Tech	Semester	:	Winter 2023-24
Course	: Optical Fiber Communications	Code	:	BECE308L
		Class Nbr	:	CH20232405008?7 CH20232405026?5 CH20232405026?3 CH20232405026?7 CH20232405026?9
Faculty	: Dr. Sivasubramanian A Dr. Sangeetha RG Dr. Chitra K Dr. Ilavarasan T Dr. Balaji VR Ms. Divya J	Slot	:	C2
Time	: 90 Minutes	Max. Marks	:	50

Answer ALL the questions

Constants: $h = 6.625 \times 10^{-34}$ J.s, $c = 3 \times 10^{8}$ m/s, $q = 1.6 \times 10^{-19}$ C $k_B = 1.380 \times 10^{-23}$ J/K

Q.No.	Sub. Sec.	Questions (Each subdivision has equal weightage)	Marks
1.		An engineer wish to design a GaAlAs LED source with an active region width of 2 μm operating at 300K and current density of 120 A/cm^2 for a transmitter operating in the modulation frequency range of 20 MHz to 200 MHz. The steady state electron density at this current density is 7×10^{16} cm^{-3}.When there is no information signal in transmitter input circuitry, the optical output power is 0.35 mW. Find the (a) carrier lifetime of the electron (b) 3 dB optical cut-off frequency (c) 3 dB electrical bandwidth (assume pulses are Gaussian in nature) (d) optical output power at modulation frequencies of 20 MHz and 200 MHz.	[10]
2.		A laser diode made of $In_{1-x}Ga_xAs_yP_{1-y}$ alloy has an optical cavity length of 250 μm and refractive index of 4.0. The x and y values are 0.26 and 0.57 respectively. If at half-power point, λ-λ_o is 3 nm on a Gaussian shaped gain curve, find the (a) peak emission wavelength of this diode (b) number of half-wavelengths spanning the cavity length (c) frequency spacing between the modes of the cavity (d) spectral width of the gain (e) threshold gain for this cavity if its ends are uncoated and the cavity absorption coefficient is 12 cm^{-1}.	[15]
3.	a	If the absorption coefficient of silicon is 0.05 μm^{-1} at 860 nm, find the penetration depth at which $P(x)/P_{in} = 0.368$	[4]

Consider a *pin* photodiode whose depletion region width is 20 μm. The absorption coefficients for the different wavelengths are given below. Calculate and plot the quantum efficiencies and responsivity:

Wavelength (nm)	Absorption coefficient (cm^{-1})	Quantum efficiency	Responsivity (A/W)
800	$0.97*10^3$		
900	370		
1000	70		

b [6]

An engineer designed an optical receiver with a modulation index of 0.2, bandwidth of 30 MHz, operating at a wavelength of 1300 nm, using InGaAs *pin* photodiode with the following specifications: the dark current is 5 nA, efficiency of the diode is 0.70 and, the load resistance is 1500 Ω. The root mean square shot noise current is 1.2 nA, surface leakage current is negligible and the incident optical power is 200 nW. Assess the performance of the receiver by computing the following: [10]

4.
(i) primary photo current
(ii) bandwidth of the receiver
(iii) mean square dark current
(iv) mean square thermal noise current
(v) SNR.

An engineer designed a receiver circuit using a photodiode with a variable potentiometer as the load resistor, so as to work in the bandwidth range of 20 MHz to 500 MHz. The photodiode has a capacitance of 2 pF. The amplifier connected to this photodiode has an input impedance of $10x10^6$ Ω and a capacitance of 6 pF. Calculate the range of potentiometer which will suit for the efficient operation of this receiver. [5]

5.

Total [50]

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