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ECE Dept.
Exam.
Internal Assessment
Even Sem(2018-19)

SECOND INTERNAL ASSESSMENT

Sem: VIII
Date: 11/04/2019
Sub: Fiber Optics and N/W
Time: 3.00-4.00 pm
Sub. Code: 15EC82
Max. Marks:25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Description of Question	Marks	CO	RBT LEVEL
1	a	Explain with suitable energy band diagram, the working of a heterostructure LED.	6	C402.3	L1,L2
	b	A heterostructure LED has T_r =30 nsec, T_{nr} = 100nsec with a drive current of 40mA and λ=1310nm. Calculate a. Bulk recombination life time b. Internal Quantum Efficiency c. Internal Power level.	6	C402.3	L1,L2
		OR			
2	a	Expalin with a suitable energy band diagram, the 3 major processes involved in the operation of a Laser diode.	6	C402.3	L1,L2
	b	Explain with a suitable diagram the working of Fabry-Perot resonator Lase diode and compare it with DFB laser.	6	C402.3	L1,L2
3	a	What are the requirements of a photo detectors? Explain the working of of a PIN photo diode with a suitable diagram.	7	C402.3	L1,L2
	b	A laser source has a cavity length of 500μm, R_1=R_2=0.32and =10cm^{-1} Calculate the threshold gain of laser cavity and show it using chareteristics of laser diode.	6	C402.3	L1,L2
		OR			
4	a	Discuss the various types of noises associated with optical detector and obtain the expression for SNR.	7	C402.3	L1,L2
	b	ASilicon photo diode has quantum efficiency of 65% at a wavelength of 900nm. A power of 0.5μW produces a multiplied current of 10μA. Calculate Ip (Primary Photocurrent) and M (multiplication factor) of photodiode.	6	C402.3	L1,L2

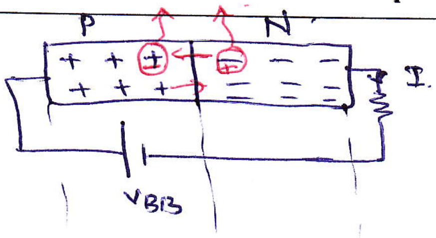
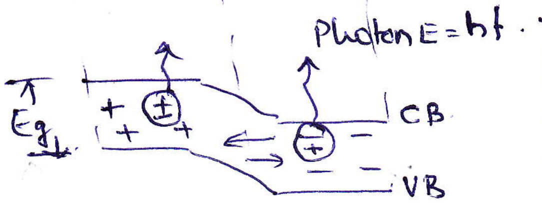
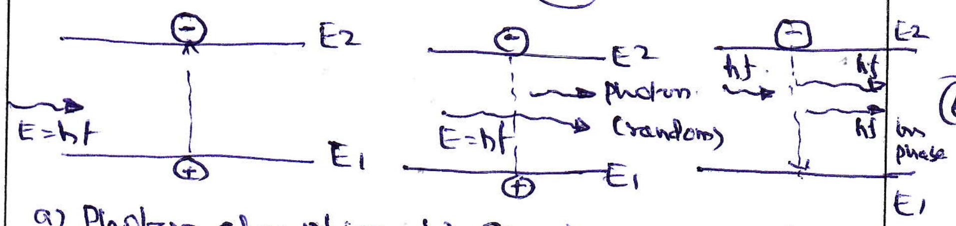
M.H. [signature]
Course Coordinator

Module Coordinator

HOD

IIIA - SCHEME OF EVALUATION

Sem : VIII	Subject : fiber Optics & N/W	Sub Code : 15EC82	Date : 11/4/19

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
1	a)	 } 2M  } 1M 3M **Explanation under FB:** Majority carriers from 'P' material (holes) cross over junction and combine with electrons of 'N' material and vice-versa. Under favorable condtⁿ, they combine radiatively to generate photon of energy $E = hf$. Each combination results in a photon.	6	C402.3	L1, L2
	b)	$\tau_r = 30ns$ $\tau_{nr} = 100ns$ $I = 40mA$ $\lambda = 1310nm$ a) $\tau = \frac{\tau_r \cdot \tau_{nr}}{\tau_r + \tau_{nr}} = \frac{30 \times 100}{30 + 100} = 23.1\ ns$ —— (2M) b) Int. quantum $\eta = \eta_{int} = \tau/\tau_r = \frac{23.1}{30} = 0.77$ (2M) c) $P_{int} = \eta_{int} \cdot \frac{I h c}{q \lambda} = \frac{40 \times 10^{-3} \times 6.625 \times 10^{-34} \times 3 \times 10^{8}}{1.602 \times 10^{-19} \times 1310 \times 10^{-9}}$ $P_{int} = 29.2\ mW$ —— (2M)	6	C402.3	L1, L2
2	a)	 a) Photon absorption b) Spontaneous emission. c) Stimulated emission.	6	C402.3	L1, L2

M.M. Yadav
Staff-In-Charge

Module Coordinator

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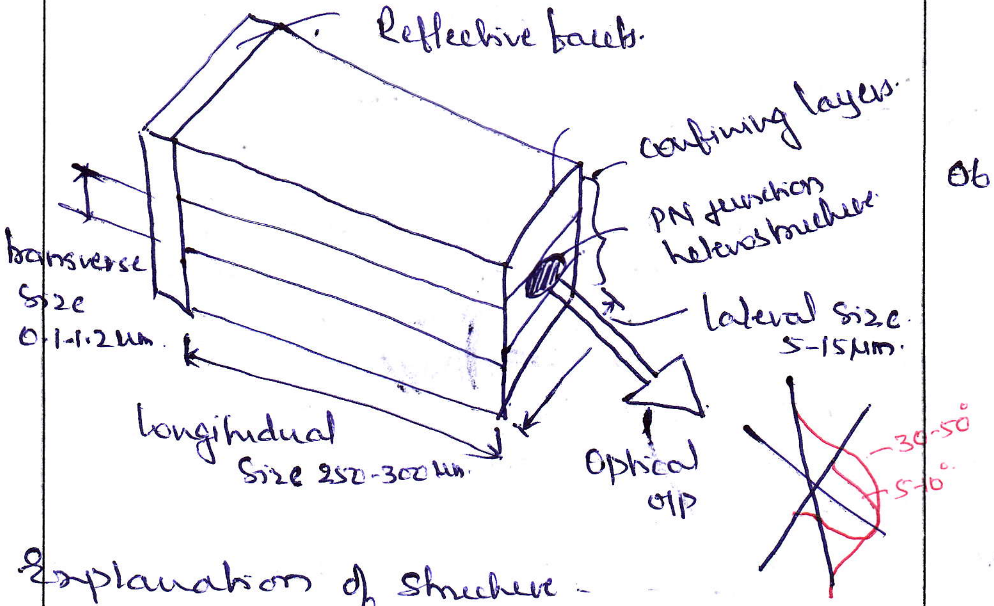
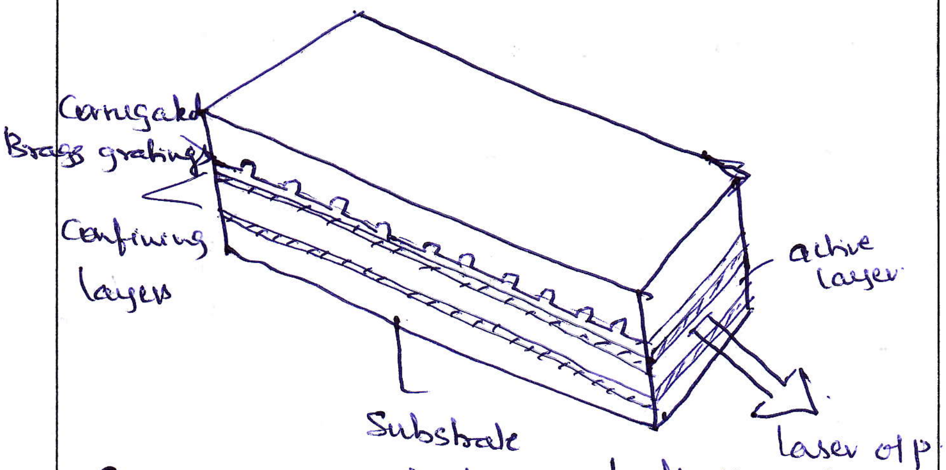
Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
		Explanation of 3 process. – Condition of population inversion.			
	b)	FB resonator laser:  Explanation of structure - - Method of providing feedback. DFB laser: -  Comparision in terms feedback mechanism	06	C402.3	L1, L2

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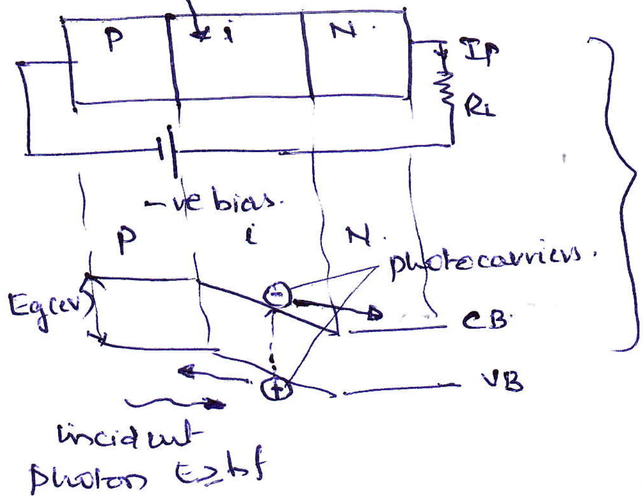
Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
Q3	a.	(see below)	7	C402.3	L1, L2
	b)	(see below)	6M	C402.2	L1, L2

Q3 a.

Requirements of photo detectors:

1) They should have high sensitivity & Responsivity at operating wavelength.
2) Operating wavelength $\lambda(\mu m) = 1.24/E_g(eV)$ should match to source wavelength.
3) Physical size should be compatible with fiber dimensions.
4) Should have longer lifespan, cheaper cost and easily available. — 2M

PIN photo diode:



— 2M

Explanation of construction & working — 3M

b) $L = 500\,\mu m$ $R_1 = R_2 = 0.32$ $\bar{\alpha} = 10/cm$

$$g_{th} = \bar{\alpha} + \frac{1}{2L}\ln\left(\frac{1}{R_1 R_2}\right)$$ — 2M

— 1M

$$= 10 + \frac{1}{2(500\times10^{-4})}\ln\left(\frac{1}{0.32^2}\right)$$

$g_{th} = 33\ cm^{-1}$ — 3M

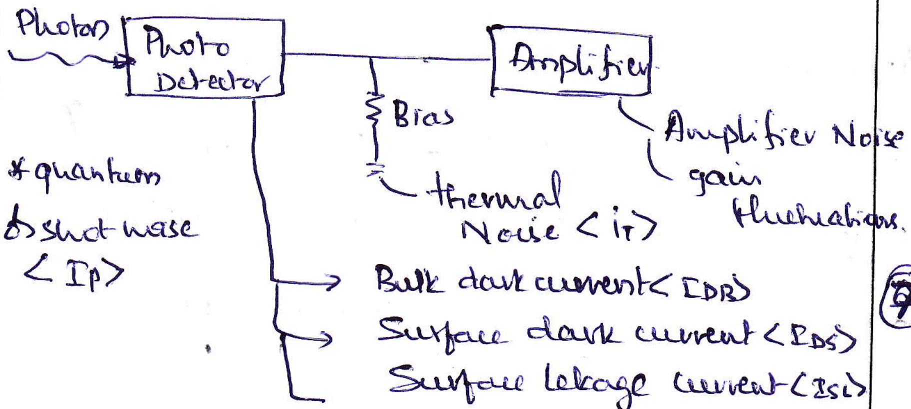
M.M. [signature] Staff-In-Charge | [signature] Module Coordinator | [signature] HOD

II IA - SCHEME OF EVALUATION

Sem : VIII	Subject : Fiber optics & N/W	Sub Code : 15EC82	Date : 11/4/19.

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
4	a.	(diagram and equations below)	9	C402.3	L1, L2
	b)	(solution below)	6	C402.3	L1, L2

4 a.



a) $\langle i_P \rangle^2 = 2q \cdot I_P \cdot B \cdot M^2 \cdot F(M)$.

$\langle i_{DB} \rangle^2 = 2q\, I_D\, B\, M^2\, F(M)$.

$\langle i_{DS} \rangle^2 = 2q \cdot I_L \cdot B$.

$\langle i_T \rangle^2 = \dfrac{4kTB}{R_L}$.

b)

$$I_P = \frac{\eta q \lambda}{hc} \cdot P_{in}$$

$$= \frac{0.65 \times 1.60 \times 10^{-19}) \times 900 \times 10^{-9} \times 0.5 \times 10^{-6}}{6.625 \times 10^{-34} \times 3 \times 10^{8}}$$

$$I_P = 0.235\ \mu A.$$

$$M = \frac{I_M}{I_P} = \frac{10\ \mu A}{0.235\ \mu A} = 43$$

⇒ Primary current is multiplied by 43 times.

Staff-In-Charge (H.M. Gadagi) — Module Coordinator — HOD