GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2020-2021

OPTOELECTRONICS & FIBRE OPTIC SENSORS

EI504A

TIME ALLOTTED: 3 HOURS **FULL MARKS: 70**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

			Marks	CO No
1.	i)	To reduce attenuation in signal traveling through an optical fiber, normally the light ray used is: a) UV ray b) visible light c) mid-infrared ray d) far-infra red ray	1	CO5
	ii)	Phonon is a- a) packet of energy b) quantum of vibrational energy of lattice c) quantum of electromagnetic radiation d) none of these	1	CO2
	iii)	Stimulated emission is achieved by a) population inversion b) optical cavity c) suitable materials d) a and c	1	CO2
	iv)	The performance characteristics of multimode graded index fibers is a) better than multimode step index fibers. b) same as multimode step index fibers. c) lesser than multimode step index fibers d) negligible	1	CO1
	v)	Degenerative doping is used in a) ILD b) LED c) PIN photodiode d) none of these	1	CO1

vi)	The Dark Current in the Photo Diode is actually the- a) Forward Current Through the Junction b) Reverse Saturation Current c) Basically, an output Radiation d) None of These		1	CO2
vii)	In …… propagation, the beam of propagated light is almost horizontal and the low-density core has a small diameter compared to the cores of the other propagation modes. a) multimode step index b) multimode graded index c) multimode single index d) single mode		1	CO3
viii)	The bending loss in an optical fiber can be used to measure a) displacement b) strain c) pressure d) force		1	CO4
ix)	The P-I-N Diode has a …… Depletion Layer width a) largely doped b) controllable c) large d) none of these		1	CO2
x)	Intermodal dispersion is less in a) single mode graded index fiber b) Multimode Graded index fiber c) GRIN fiber d) None of the above		1	CO3
xi)	Which of the following materials is not suitable for making an LED a) GaAs b) Silicon c) GaAlAs d) InGaAsP		1	CO2
xii)	Multimode step index fiber has _____ a) Large core diameter & large numerical aperture b) Large core diameter and small numerical aperture c) Small core diameter and large numerical aperture d) Small core diameter & small numerical aperture		1	CO3

GROUP – B*

(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

			Marks	**CO No**
2.	a)	What is numerical aperture (NA) of an optical fiber?	2	CO3

	b)	Derive the expression for NA in terms relative refractive index of a step-index fiber.	3	CO3
3.	a)	What do you understand by spontaneous and stimulated emission?	4	CO2
	b)	What is 'shot noise' in photodetector?	1	CO2
4.	a)	Show that in a photodiode, under photoconductive mode of operation, the output voltage is a Logarithmic function of the incident optical Irradiance	5	CO2
5.	a)	What do you mean by Q-Switching in laser?	2	CO1
	b)	Calculate the ratio of the stimulated emission rate to the spontaneous emission rate for an incandescent lamp operating at a temperature of 1000K. It may be assumed that the average operating wavelength is 0.5μm.	3	CO1
6.	a)	Discuss how population inversion is achieved in semiconductor laser.	4	CO1
	b)	What is the use of Q-switching?	1	CO1

GROUP – C*
(Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

			Marks	CO No.
7.	a)	Explain the Principle of holography. Discuss the holographic technique invented by Gabor	5	CO1
	b)	Discuss the working of Computer Holographic memory with a suitable diagram	8	CO1
	c)	What are the advantages of holography over 2D photography?	2	CO1
8.	a)	What do you mean by internal quantum efficiency of an LED? Derive the relation between the Internal Quantum Efficiency of LED and the life time of transitions.	3	CO1
	b)	Calculate the power from an n+ - p GaAs LED with an electron current of 1 mA and efficiency η_0 = 50 %. Assume wavelength of GaAs LED as 0.87 μm. Deduce the relation you have used.	4	CO1
	c)	Draw and explain the structure of Planar LED.	3	CO1
	d)	What do you mean by Responsivity of a Photo Detector? What is 'long wavelength cutoff' of a photodetector	2	CO1
	e)	Why do the reflective losses occur in LED and explain how it can be minimized?	3	CO1
9.	a)	What is meant by 'mode' in an optical fiber? Draw the modes in a step-index (SI) planar waveguide for m=0 and m=1, where 'm' is related to the normalized frequency 'V' by V=mπ/2.	5	CO3

	b)	A symmetric SI fiber has n_1=2.2, n_2=1.8. The thickness of the guide layer is 9.85 μm. The wavelength of the ray of light passing through the fiber is λ=0.85 μm. What are the values of the phase propagation constants? What is the maximum number of modes that the fiber can support? What should have been the thickness of the guide layer if it were to support only the fundamental mode, assuming all other parameters and aspects remain same?	8	CO3
	c)	What is intermodal dispersion?	2	CO3
10.	a)	What are the features of a good connector?	2	CO5
	b)	What is the difference between Meridional rays and Skew rays? Why cladding used in optical fibre cable?	4	CO3
	c)	Describe an optical fibre sensor system with suitable block diagram.	3	CO4
	d)	How do you measure temperature using optical fibre sensor?	3	CO4
	e)	What is WDM? Explain with suitable diagram.	3	CO5
11.		Write short notes on any three of the following: 3 x 5 =15		
	a)	Basic fiber optic communication system	5	CO5
	b)	Phototransistors	5	CO2
	c)	Types of losses in signal in an optical fiber	5	CO3
	d)	Avalanche photodiode	5	CO2
	e)	Mach –Zahnder interferometer	5	CO4