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B.Tech. DEGREE EXAMINATION, JUNE 2023

Seventh Semester

18ECE226T - OPTICAL COMPONENTS, SYSTEMS AND NETWORKS

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40 minutes.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

		Marks	BL	CO
	Part - A (20 × 1 Marks = 20 Marks) Answer **All** Questions			
1.	Which among the following range of wavelengths is termed the optical C band? (A) 1260 – 1360 nm (B) 1460 – 1530 nm (C) 1530 – 1565 nm (D) 1625 – 1675 nm	1	1	1
2.	Assume a glass rod surrounded by air. If the refractive index, n1 of the glass rod equals 1.6 and n2 equals 1, then the critical angle is (A) 28.5° (B) 38.68° (C) 40.5° (D) 42.58°	1	3	1
3.	When three wave components co-propagate at angular frequency ω1, ω2, ω3, then a new wave is generated at frequency ω4, which is given by _____ (A) ω4=ω1 – ω2 – ω3 (B) ω4=ω1 + ω2 + ω3 (C) ω4=ω1 + ω2 – ω3 (D) ω4=ω1 – ω2 + ω3	1	2	1
4.	In fusion splicing, the splice losses typically are in the range of (A) 0.05 – 0.10 dB (B) 0.1 – 0.2 dB (C) 0.07 – 0.2 dB (D) 0.2 – 0.5 dB	1	1	1
5.	Carrier Confinement in LED structure is achieved through _____ of adjacent layers (A) Difference in Refractive index (B) Difference in Bandgap (C) Difference in width (D) Difference in doping concentration	1	1	2
6.	In LCD, molecules are arranged parallel to each other in _____ orientation. (A) Nematic (B) Cholestric (C) Smectic (D) Dipole	1	1	2
7.	When excitation arises because of bombardment of electrons is called as _____ (A) Electroluminescence (B) Cathodoluminescence (C) Photoluminescence (D) Phosphorescence	1	1	2
8.	Determine the internal quantum efficiency generated within a device when it has a radiative recombination lifetime of 80 ns and total carrier recombination lifetime of 40 ns. (A) 20 (B) 50 (C) 30 (D) 40	1	3	2
9.	What will be the responsivity of a Germanium PIN Photodiode at 1300nm? (A) 0.45A/W (B) 0.65A/W (C) 0.9A/W (D) 0.8A/W	1	1	3

10.	_____ is the photodiode circuit bandwidth with C_T=5pF and R_T=2kW (A) 15.9MHz (B) 62MHz (C) 628MHz (D) 159MHz	1	1	3
11.	Compute the photocurrent of RAPD having multiplication factor of 36.7 and output current of 7μA. (A) 0.01 μA (B) 0.07 μA (C) 0.54μA (D) 0.9 μA	1	3	3
12.	_____ measures optical power as a function of wavelength (A) Optical Spectrum Analyser (B) Optical power attenuator (C) Optical power meter (D) Optical time domain reflectometer	1	1	3
13.	Which effect induces a strain and change in refractive index in optoelectronics? (A) Kerr effect (B) Pockels effect (C) Photoelastic effect (D) Applied magnetic field	1	2	4
14.	What is the technique used to bond and fabricate optoelectronics and electronic components? (A) Monolithic integration (B) Hybrid integration (C) CMOS Technology (D) NMOS technology	1	1	4
15.	For a optical modulator, if there is no presence of mismatch between the phases, the mismatch is represented as, (A) $\Delta\beta=\infty$ (B) $\Delta\beta=1$ (C) $\Delta\beta=-1$ (D) $\Delta\beta=0$	1	1	4
16.	What is the condition to be satisfied for Bragg's regime? (A) $L>>\Lambda/\lambda$ (B) $L=\Lambda 8/\lambda$ (C) $L<<\Lambda 2/\lambda$ (D) $L>>\Lambda 2/\lambda$	1	1	4
17.	Which method determines the dispersion limitation of an optical link? (A) Link power budget (B) Rise time budget (C) Fall time budget (D) Link and rise budget	1	1	5
18.	Faraday rotator is used in _____ (A) Mach Zehnder Interferometer (B) Fabry Perot Filter (C) Isolator (D) Directional Couplers	1	1	5
19.	_____ couplers divide the power equally (A) 3 dB (B) 6 dB (C) 9 dB (D) 12 dB	1	2	5
20.	The function of wavelength-division multiplexer is to _____ (A) Separate signals at different wavelengths and couple them to different detectors. (B) Combine signals at different wavelengths to pass through a single fiber. (C) Tap off part of the energy of the incoming signal. (D) Change the transmission speed of the input signal.	1	2	5

Part - B (5 × 4 Marks = 20 Marks) — Marks BL CO

Answer **any 5** Questions

21.	A manufacturer wishes to make a silica core step index fiber with V=75 & NA=0.3 to be used at 820nm. If n1=1.458, determine core radius & cladding index.	4	3	1
22.	Draw the amplification mechanism of the Erbium Doped Fiber Amplifier with the help of an energy level diagram.	4	2	2
23.	A silicon photodiode has a quantum efficiency of 65% at a wavelength of 900 nm. Suppose 0.5 μW of optical power produces a multiplied photocurrent of 10 μA. What is the photo multiplication factor M.	4	4	3

24.	Explain how Pockels cell modulator works on Electro Optic Effect.	4	2	4
25.	Elaborate Optical MEMS Switches.	4	2	5
26.	Explain the various functions of data conversion unit	4	2	2
27.	In a Si Photodiode when a radiation of wavelength 700nm and generates a photocurrent of 56.6nA. What is the responsivity and quantum efficiency of the photodiode.	4	3	3

Part - C (5 × 12 Marks = 60 Marks) — Marks BL CO

Answer **All** Questions

28.	a.From the wave equations for step-index fibers arrive at the boundary conditions for bounded modes. **(OR)** b.(i) Elaborate material and waveguide dispersion with necessary equations. [8 Marks] (ii) An LED operating at 850nm has a spectral width of 55nm and launches the power in 1Km fiber. What is the pulse spreading due to material dispersion? Given $(d^2n)/(d\lambda^2)=4\times10^{-2}$ μm^{-2} .[4 Marks]	12	3	1
29.	a.Derive the threshold lasing condition of a LASER diode. **(OR)** b.Explain the mechanism of electro luminescence with neat diagram and also explain about operation of ac electroluminescence device.	12	4	2
30.	a. Draw and explain the functional blocks of a receiver module. **(OR)** b. List the various noise sources in photodetector and elaborate them with suitable equation.	12	4	3
31.	a. Explain principle of acousto-optic effect and modulator based on acousto-optic effect with thin grating. **(OR)** b. Demonstrate an interferometer which operates on the principle of electro-optic effect and derive the expression for bias voltage at which the modulation index is unity.	12	4	4
32.	a. A type-I intensity-modulated analog fiber-optic link employs a laser transmitter which couples a mean optical power of 1 dBm into a multimode optical fiber cable. The cable exhibits an attenuation of 2.5 dB/km with splice losses estimated at 0.45 dB/km. A connector at the receiver end shows a loss of another 1 dB. The p-i-n photodiode receiver has a sensitivity of –27 dBm for a CNR of –50 dB with a modulation index of 0.45. A safety margin of 6 dB is required. The rise times of the ILD and p-i-n diode are 1.5 ns and 4.5 ns, respectively, and the intermodal and intramodal rise times of the fiber cable are 8 ns/km and 3 ns/km, respectively. (i) What is the maximum possible link length without repeaters? (ii) What is the maximum permitted 3-dB bandwidth of the system? **(OR)** b. With a neat block diagram explain the operational principle of Radio- Over- Fiber. Mention its key link parameters used for designing.	12	3	5

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