Reg. No.																

Question Paper Code	13181

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Seventh Semester

Electronics and Communication Engineering

20ECPC702 - OPTICAL COMMUNICATION

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	For which condition ray optic principles break down among the relationship between wavelength (λ) and aperture size (d) given below: (a) d<< λ (b) d>=λ (c) d>> λ (d) d> λ	1	K1	CO1
2.	In a fiber, the refractive index of the core is twice that of the refractive index of cladding. Then, the critical angle is (a) 25^o (b) 30^o (c) 35^o (d) 37^o	1	K2	CO1
3.	V- number for the single mode fiber is _____. (a) Less than or equal to 2.405 (b) Greater than or equal to 2.405 (c) Equal to 2.450 (d) Equal to 2.405	1	K1	CO1
4.	SBS and SRS are types of _____. (a) Linear scattering (b) Non-linear scattering (c) Fiber bending losses (d) Core-cladding losses	1	K1	CO2
5.	If the input power 100μW launched into a 6Km fiber, the mean optical power at the fiber output is 2 μW. What is the overall signal attenuation through the fiber assuming there are no connectors or splicers? (a) 15.23dB (b) 17.12dB (c) 16.98dB (d) 18.56dB	1	K2	CO2
6.	Variation of refractive index of the core material as function of wavelength caused _____ (a) Polarization mode dispersion (b) Material dispersion (c) Waveguide dispersion (d) Intermodal dispersion	1	K1	CO2
7.	The semiconductor material NOT used in LED is_____. (a) Silicon (b) Silicon Carbide (c) GaAsP (d) GaAs	1	K1	CO3
8.	A double hetero-structure is designed with the composition of the quaternary alloy, In_{1-x} Ga_x As_y P_{1-y} is such that x/y=1/2.2 and x=0.4. What is the operating wavelength of the designed semiconductor device? Assume $E_g(y)=1.35-0.72y+0.12y^2$ eV. (a) 1550nm (b) 1532nm (c) 1520nm (d) 1480nm	1	K2	CO3
9.	_____ is a non-coherent light source for optical communication system. (a) ILD (b) LED (c) APD (d) PIN Diode	1	K1	CO3
10.	Low impedance preamplifiers can operate over a _____ bandwidth and do not provide _____ receiver sensitivity. (a) wide, high (b) wide, low (c) narrow, low (d) narrow, high	1	K2	CO4
11.	A digital fiber optic link operating at 850nm requires a minimum BER of 10^{-9}. _____ is the required average photons per pulse. (a) 24 (b) 18 (c) 21 (d) 15	1	K2	CO4
12.	When the optical power incident on a photodiode is 10μW and the responsivity is 0.8 A/W, the photocurrent generated (in μA) is _____. (a) 10μA (b) 8μA (c) 25 μA (d) 18 μA	1	K2	CO4
13.	The range of BER for an optical system is_____. (a) 10^{-9} to 10^{-12} (b) 10^{-3} to 10^{-12} (c) 10^{-12} to 10^{-14} (d) 10^{-6} to 10^{-12}	1	K1	CO4

14.	What is the use of an index-matching material in the connector between the two jointed fibers? (a) To decrease the light transmission through the connection (b) To increase the light transmission through the connection (c) To induce losses in the fiber (d) To make a fiber dispersive	*1*	*K1*	*CO5*
15.	A permanent bond is referred as a_____. (a) T-joint (b) Splice (c) Fiber jointing (d) Connections	*1*	*K1*	*CO5*
16.	The technique used for determining the refractive index profile can be used to measure the _____. (a) Core Radius (b) Core Diameter (c) Cladding diameter (d) Wavelength	*1*	*K1*	*CO5*
17.	Which of the following is the equation used for calculating the minimum number of wavelengths required for a wavelength routed network? (a) N=2L+C/λ (b) N=L+C/ λ (c) N=L+C/2 λ (d) N=2(L+C)/ λ	*1*	*K1*	*CO6*
18.	**Assertion:** Wavelength routed networks have a high data transmission rate. **Reasoning:** In wavelength routed networks, data is transmitted through multiple channels simultaneously. (a) Both assertion and reasoning are true, but reasoning is not the correct explanation of assertion (b) Assertion is true, but reasoning is false (c) Both assertion and reasoning are true and reasoning is the correct explanation of assertion (d) Assertion is false, but reasoning is true	*1*	*K2*	*CO6*
19.	When was the Gigabit Ethernet network developed? (a) 1977 (b) 1988 (c) 1990 (d) 2002	*1*	*K1*	*CO6*
20.	Which of the following is not an element of Broadcast and select WDM network? (a) Amplifiers (b) Multiplexers (c) Modulators (d) Demultiplexers	*1*	*K1*	*CO6*

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21.	Distinguish meridional rays and skew rays.	*2*	*K2*	*CO1*
22.	For n1=1.55 and n2=1.52, Calculate the Critical angle and Numerical Aperture.	*2*	*K2*	*CO1*
23.	When the mean optical power launched into a 8 Km fiber is 120 μw, the mean optical power at the fiber output is 3 μw. Calculate the overall attenuation in dB by assuming there are no splices.	*2*	*K2*	*CO2*
24.	What's Urbach's rule?	*2*	*K1*	*CO2*
25.	Write two differences between LED and Laser diode.	*2*	*K1*	*CO3*
26.	Calculate the external differential quantum efficiency of a laser diode operating at 1330nm. The slope of the straight line portion of the curve for the emitted optical power P versus drive current I is given by 15 mW/mA.	*2*	*K2*	*CO3*
27.	What are the various error sources in the optical receiver?	*2*	*K1*	*CO4*
28.	Mention few fiber diameter measurement techniques.	*2*	*K1*	*CO5*
29.	Distinguish between splicer and connector.	*2*	*K2*	*CO5*
30.	List out the features of DWDM.	*2*	*K1*	*CO6*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31.	a)	Explain ray theory transmission in an optical communication with neat diagram. Explain acceptance angle, numerical aperture and total internal reflection using Snell's law with relevant figures and calculations.	*10*	*K2*	*CO1*

OR

	b)	Starting from Maxwell's equation, derive the expression of wave equation of an electromagnetic wave propagating through optical fiber.	*10*	*K2*	*CO1*
32.	a)	Suggest and validate the techniques employed and the fiber structures utilized to provide (i) Dispersion shifted single mode fibers (ii) Dispersion flattened single mode fibers.	*5+5*	*K2*	*CO2*
		OR			
	b)	Derive the expressions for material and waveguide dispersion and explain them.	*10*	*K2*	*CO2*
33.	a)	With a neat sketch, discuss the structure and working principle of surface emitting LED and Edge emitting LED.	*10*	*K2*	*CO3*
		OR			
	b)	Explain the working principle of laser diode and derive its rate equation.	*10*	*K2*	*CO3*
34.	a)	Draw the structures of Pin and APD photo detectors and explain their operations.	*10*	*K2*	*CO4*
		OR			
	b)	Describe the terms: - Quantum limit and Probability of error with respect to a receiver with typical values.	*10*	*K2*	*CO4*
35.	a)	Discuss with the aid of a suitable diagram the cut- back technique used for the measurement of the total attenuation in an optical fiber. Indicate the differences in the apparatus utilized for spectral loss and spot attenuation measurement.	*10*	*K2*	*CO5*
		OR			
	b)	Derive an expression for the power coupled into a step index fiber from an LED that has a radiant distribution of $B(\theta) = B0 \cos \theta$.	*10*	*K2*	*CO5*
36.	a)	An Engineer has the following components available: (a) GaAlAs laser diode, operating at 850nm, fiber coupled power 0dbm (b) Ten sections of cable each of which is 500m long, has 4dB/km attenuation has connectors at both ends (c) 2dB/connector connector loss (d) A PIN photodiode receiver, -45 dBm sensitivity (e) An avalanche photodiode receiver,-56dBm sensitivity The engineer wishes to construct a 5km link operating at 20 Mb/s. Estimate which receiver should be used if a 6dB operating margin is required.	*10*	*K3*	*CO6*
		OR			
	b)	Briefly explain the SONET frame structures and develop the SONET/SDH rings for wide area network with neat diagram.	*10*	*K3*	*CO6*