ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

ELECTRONICS AND COMMUNICATION ENGINEERING
Seventh Semester
EC5701 - MILLIMETER AND OPTICAL WAVE COMMUNICATION
(Regulation2019)

Time:3hrs   Max.Marks: 100

CO1	Ability to understand fundamentals & millimeter wave communication
CO2	Ability to design millimeter wave communication systems
CO3	Ability to understand and apply fiber transmission characteristics
CO4	Ability to understand and analyze optical transmitters and receivers
CO5	Ability to understand & apply free space optical systems

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

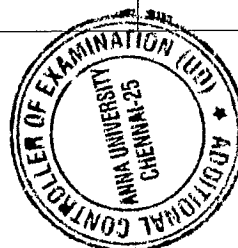| Q.No.	Questions	Marks	CO	BL
1	Find the free space loss for a mmwave communication with the operating frequency range of 3.5 GHz. Assume the distance between the antennas is 10m.	2	1	L2
2	What is GI-FI? Mention the difference between LiFi and Gi-Fi?	2	1	L1
3	An infinite ground plane and that the radius of the sphere that can enclose the antenna is a = 5 mm at 60 GHz calculate the maximum Gain and gain-to-Q.	2	2	L2
4	What is polarization diversity? What are the disadvantages of polarization diversity?	2	2	L1
5	What are the types of rays propagate along a fiber and draw.	2	3	L1
6	Consider a Multimode step index optical fiber that has a core radius of 25 µm, a core index of 1.48 and an index difference Δ = 0.01. Find the % of optical power that propagate in the cladding at 840 nm.	2	3	L2
7	Assume a typical value of n = 4 for the refractive index of an LED material. What percent of the internally generated optical power is emitted into anair medium?	2	4	L2
8	What is Electrical and Optical 3dB bandwidths.	2	4	L1
9	Define the point ahead angle and determine the point ahead angle for a LEO satellite moving at a speed of 3 m/s.	2	5	L2
10	Mention Various types of scanning techniques ?	2	5	L1

Q.No.	Questions	Marks	CO	BL
11 (a)	i. Briefly analyze about coexistence with wireless backhaul and provide solutions to wireless backhaul.	9	1	L5
	ii. A radio link has 10W transmitter connected to an antenna of $2m^2$ of effective aperture and gain is 1.2dB at 6GHz. The receiving antenna has an effective aperture $0.4\ m^2$ and 1.2dB gain is located at a 15km line of sight distance from the transmitting antenna. Assuming system loss factor of the matched antenna is 11dB. Find the power delivered to the receiver.	4	1	L3
	OR			
11 (b)	ii. Describeand analyze in detail the FSK Modulation scheme used in Millimeter Wave Communication Systems. Substantiate with necessary equations.	9	1	L5
	ii. Draw the QPSK signals in the time domain.	4	1	L3
12 (a)	i. Draw a simple millimeter wave link and discuss about the millimeter wave link budget. Also derive the expressions for signal-to-noise ratio for the system.	9	2	L2
	ii. For2 GHz bandwidth, calculate the input noise level of the system.	4	2	L3
	OR			
12 (b)	i. Explain about the design considerations at 60 GHz patch antenna.	9	2	L2
	ii. Explain the 2 x 2 Horn Array and its Beam Switching.	4	2	L3
13 (a)	i. Explain about the mode theory for circular wave guide.	9	3	L3
	ii. A manufacturing engineer wants to make an optical fiber that has a core index of 1.5 and a cladding index of 1.45. What should be the core size for single mode operation at 1550 nm?	4	3	L3
	OR			
13 (b)	i.What is nonlinear effects? With necessary diagrams, explain nonlinear effects in Optical fibers.	9	3	L3
	ii.The beat length in a single-mode optical fiber is 10 cm when light from an injectionlaser with a spectral linewidth of 1.5 nm and a peak wavelength of 1μm is launchedinto it. Determine the modal birefringence and estimate the coherence length.	4	3	L3
14 (a)	i.Write the principle of operation of a LASER and describe the output of a LASER using the gain threshold equations. Also derive the Laser diode Rate equations.	9	4	L2
	ii. A GaAs laser operating at 850 nm has a 600-mm length and a refractive index n = 3.5. Find the frequency spacing and the wavelength spacing?	4	4	L3
	OR			
14 (b)	i. Draw and explainAvalanche Photo detector and derive the expression for its responsivity.	9	4	L2

	ii. A given silicon avalanche photodiode has a quantum efficiency of 65 percent at a wavelength of 900 nm. Suppose 0.5 mW of optical power produces a multiplied photocurrent of 10 µA. What is the multiplicationM ?	4	4	L3
15 (a)	i.With neat block diagram, explain the ATP system between the ground station and the onboard satellite. Explain Acquisition, tracking, and pointing in detail.	9	5	L3
	ii.Why 1550 nm wavelength preferred over the 780 nm wavelength for data operating wavelength in FSO?	4	5	L4
OR				
15 (b)	i. Perform Line of sight analysis for FSO	9	5	L3
	ii.Analyze the factors affecting Free Space Optics.	4	5	L4

PART- C(1x 15=15Marks)
(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	i.Analyze and discuss the channel performance at 60 GHz millimeter wave frequencies.	5	1	L4
	ii.With simple diagram analyze about Photo detector receiver and discuss the various noise sources. Derive the expression for Signal to Noise ratio.	6	4	L2
	ii. Consider the alloy $In_{0.74}Ga_{0.26}As_{0.57}P_{0.43}$ with a material ratio of x = 0.3 to be used in LED. Evaluate the peak emission wavelength and bandgap energy.	4	3	L5