COURSE CODE: 20EC0436 **R20**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code: WIRELESS COMMUNICATIONS (20EC0436)

Course & Branch: B.Tech.–ECE **Year&Sem:** IV& I **Regulation:** R20

UNIT –I

INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS

1	a)	Discuss briefly about the evolution of Mobile radio communication.	**[L1][CO1][6M]**
	b)	Tabulate list of terms used to describe various elements of wireless communication systems.	**[L1][CO1][6M]**
2	a)	Explain the two full duplex systems such as frequency division duplex (FDD) and time division duplex (TDD) in wireless communication systems.	**[L2][CO6][6M]**
	b)	Explain cordless telephone systems.	**[L2][CO6][6M]**
3	a)	Explain paging systems.	**[L2][CO1][6M]**
	b)	Explain the impact of co-channel interference on the system capacity.	**[L2][CO2][6M]**
4	a)	Describe briefly about the cellular telephone system with neat diagram.	**[L2][CO1][6M]**
	b)	Explain second generation (2G) cellular networks.	**[L2][CO5][6M]**
5	a)	Explain third generation (3G) wireless networks.	**[L2][CO2][6M]**
	b)	A spectrum of 30 MHz of bandwidth is allocated to a particular FDD cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice and control channels, compute the number of channels available per cell if a system uses (i) four-cell reuse, (ii) seven-cell reuse, and (iii) 12-cell reuse. If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell for each of the three systems.	**[L3][CO2][6M]**
6	a)	How cellular frequency reuse concept is useful in allocating same frequency channels in various cluster of cells.	**[L2][CO6][6M]**
	b)	Classify the channel assignment strategies and explain in detail.	**[L4][CO5][6M]**
7	a)	Illustrate a mobile handoff scenario at the cell boundary while a conversation is in progress.	**[L3][CO1][6M]**
	b)	Express the prioritizing handoffs and practical handoff considerations in cellular systems	**[L2][CO1][6M]**
8	a)	Discuss how to improve the cellular capacity by decreasing the D/R ratio and by keeping the cell radius unchanged?	**[L2][CO1][6M]**
	b)	Discuss the impact of adjacent channel interference on the system capacity.	**[L1][CO2][6M]**
9	a)	Explain trunking and grade of service (GOS) in cellular radio systems.	**[L2][CO2][6M]**
	b)	An urban area has a population of two million residents. Three competing trunked mobile networks (systems A, B, and C) provide cellular service in this area. System A has 394 cells with 19 channels	**[L4][CO5][6M]**

		each, system B has 98 cells with 57 channels each, and system C has 49 cells, each with 100 channels. Find the number of users that can be supported at 2% blocking if each user averages two calls per hour at an average call duration of three minutes. Assuming that all three trunked systems are operated at maximum capacity. Compute the percentage market penetration of each cellular provider.	
10	a)	How does subdividing a congested cell into smaller cells help to improve the coverage and capacity in cellular systems?	**[L3][CO3][6M]**
	b)	For given path loss exponent (i) n=4 and (ii) n=3, find the frequency reuse factor and the cluster size that should be used for maximum capacity. The signal to interference ration of 15 dB is minimum required for satisfactory forward channel performance of a cellular system. There are six co-channel cells in the first tier, and all of them are at the same distance from the mobile. Use suitable approximations.	**[L4][CO3][6M]**

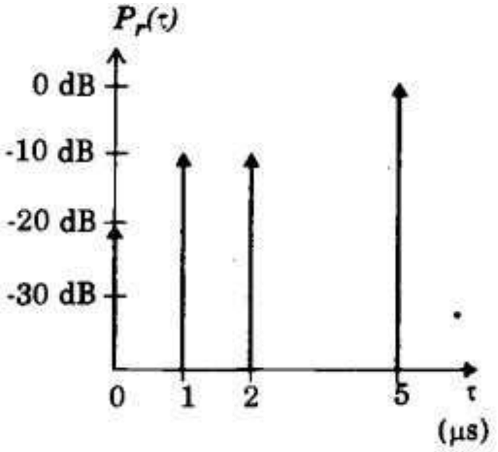
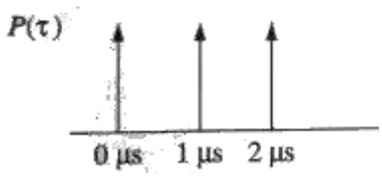
UNIT- II
MOBILE RADIO PROPAGATION

1	a)	How the received signal strength is predicted using the free space propagation model? Explain?	**[L1][CO3][6M]**
	b)	If a transmitter produces 50W of power, express the transmit power in units of dBm, dBW. If 50W is applied to a unity gain antenna with 900MHz carrier frequency, find the receiver power in dBm at a free space distance of 100m from the antenna. What is Pr (10 km)? Assume unity gain receiver antenna.	**[L4][CO5][6M]**
2	a)	Explain the ground reflection (two-ray) model. And derive the expression for total E-field envelope $\|E_{TOT}\|$.	**[L2][CO3][6M]**
	b)	Using the method of images, derive the path difference, phase difference, and path loss for the two ray model.	**[L3][CO3][6M]**
3	a)	Derive the received power at a distance d from the transmitter for the two-ray ground bounce model.	**[L3][CO3][6M]**
	b)	Briefly observe relative permittivity and conductivity of different materials at various frequencies.	**[L1][CO1][6M]**
4	a)	Calculate reflection coefficients between two dielectrics for two cases of parallel and perpendicular E-field polarization with neat diagram.	**[L3][CO3][6M]**
	b)	Illustrate with suitable diagram equivalent knife edge geometry for receiver located in shadow region and state its limitations.	**[L3][CO5][6M]**
5	a)	Derive the relation between vertical and horizontal field components at a dielectric boundary in matrix form.	**[L3][CO3][6M]**
	b)	(i) Write Brewster angle. (ii) Calculate the Brewster angle θ_B for a wave impinging on poor ground, having a permittivity of ε_r=4 at the frequency of 100 MHz. Also calculate the same for typical ground with permittivity of ε_r=15.	**[L3][CO3][2M]** **[L3][CO3][4M]**
6	a)	(i) Explain reflection from perfect conductors (ii) Explain multiple knife-edge diffraction.	**[L2][CO3][3M]** **[L2][CO3][3M]**
	b)	Find the Fraunhoher distance for an antenna with maximum	**[L3][CO1][6M]**

		dimension of 1m and operating frequency of 900MHz.If antenna have unity gain. Calculate the path loss?	
7	a)	Draw neat diagrams illustrating knife-edge geometry with appropriate notations	**[L2][CO3][6M]**
	b)	Explain the dependence of surface roughness on the frequency and angle of incidence.	**[L2][CO3][6M]**
8	a)	Explain about Fresnel zone geometry model?	**[L2][CO3][6M]**
	b)	A mobile is located at 5 km away from a base station and uses a vertical λ/4 monopole antenna with a gain of 2.55dB to receive cellular radio signals. The E field at 1km from the transmitter is measured to be 10-3V/m. The carrier frequency used for the system is 900MHz. (i) Find the length and the effective aperture of the receiving antenna. (ii) Find the received power at the mobile using the two-ray ground reflection model. Assuming the height of the transmitting antenna is 50m and the receiving antenna is 1.5m above ground.	**[L4][CO5][6M]**
9	a)	Illustrate with diagram of Fresnel zones for different knife-edge diffraction scenarios?	**[L1][CO3][6M]**
	b)	Briefly explain the three basic propagation mechanisms which impact propagation in a mobile communication system	**[L2][CO3][6M]**
10	a)	Explain scattering in mobile radio environment.	**[L2][CO3][6M]**
	b)	Explain radar cross section model.	**[L2][CO3][6M]**

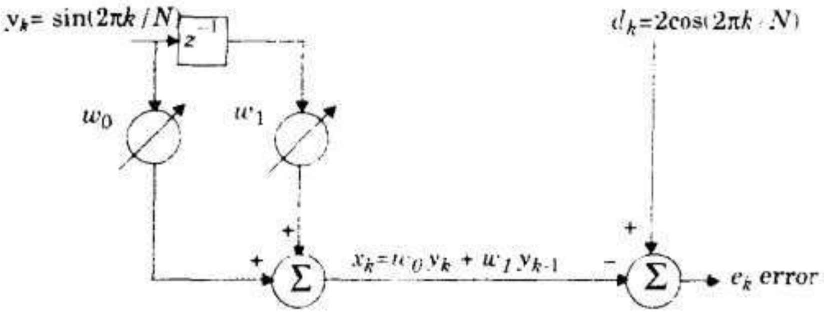
UNIT- III
SMALL-SCALE FADING AND MULTIPATH

1	a)	Describe small-scale multipath propagation.	**[L2][CO2][6M]**
	b)	In the U.S. digital cellular system, if fc=900MHz and the mobile velocity is 70km/hr, calculate the received carrier frequency if the mobile (a)directly toward the transmitter (Positive Doppler shift), (b) directly away from the transmitter (Negative Doppler shift) and (c) in the direction perpendicular to the direction of the arrival of the transmitted signal.	**[L2][CO3][6M]**
2	a)	Describe the factors influencing small scale fading in the radio propagation channel	**[L2][CO1][6M]**
	b)	The speed of the aircraft is 500km/hr and it is heading towards the airport control tower at an elevation of 25 degrees. The communication between the aircraft tower and the plane takes place at a frequency of approximately 128MHz. What is the expected Doppler shift of the received signal in positive and negative direction?	**[L4][CO5][6M]**
3	a)	Illustrate the Doppler shift in radio propagation.	**[L2][CO2][6M]**
	b)	Explain parameters of mobile multipath channels and Time dispersion parameters.	**[L2][CO1][6M]**
4	a)	Describe about coherence bandwidth in multipath channel model.	**[L2][CO6][6M]**
	b)	Calculate the mean excess delay, rms delay spread, and the maximum excess delay (10dB) for the multipath profile given in the picture	**[L4][CO5][6M]**

		below. Estimate the 50% coherence bandwidth of the channel. Would this channel suitable for AMPS or GPS service without the use of an equalizer? 	
5	a)	Describe Doppler spread and coherence time in time varying nature of the channel in small-scale region.	**[L2][CO3][6M]**
	b)	Compute the rms delay spread for the following power delay profile  (i) Calculate the rms delay spread for the given figure. (ii) If BPSK modulation is used, what is the maximum bit rate that can be sent through the channel without needing an equalizer.	**[L4][CO5][6M]**
6	a)	Classify different types of small-scale fading	**[L3][CO2][6M]**
	b)	Determine the proper spatial sampling interval required to make small-scale propagation measurements which assume that consecutive samples are highly correlated in time. How many samples will be required over 10 m travel distance if f_c=1900MHz and v=50 m/s. How long would it takes to make these measurements, assuming they could be made in real time from a moving vehicle? What is the Doppler spread B_D for the channel	**[L3][CO5][6M]**
7	a)	Evaluate flat fading effects due to Multipath time delayspread.	**[L4][CO6][6M]**
	b)	A vehicle receives a 900MHz transmission while traveling at a constant velocity for 10 s. the average fade duration for a signal level 10 dB below the rms level is 1 ms. How far does the vehicle travel during the 10 s interval? How many fades does the signal undergo at the rms threshold level during a 10 s interval? Assume that the local mean remains constant travel.	**[L4][CO5][6M]**
8	a)	Evaluate frequency selective fading due to Multipath time delay spread.	**[L4][CO3][6M]**
	b)	If the coherence bandwidth is calculated as 100 kHz in the given radio channel of 900 MHz frequency, calculate the maximum symbol rate that can be transmitted over this channel that will suffer minimal intersymbol interference.	**[L4][CO5][6M]**
9	a)	Evaluate fast fading due to Doppler spread.	**[L4][CO3][6M]**
	b)	Describe all the physical circumstances that relate to a stationary	**[L2][CO5][6M]**

		transmitter and a moving receiver such that the Doppler shift at the receiver is equal to: (i) 0 Hz (ii) f_{dmax} (iii) $-f_{dmax}$ (iv) $f_{dmax}/2$.	
10	a)	Evaluate slow fading due to Doppler spread.	**[L4][CO3][6M]**
	b)	Summarize the relation between the various multipath parameters and the type of fading experienced by the signal.	**[L2][CO3][6M]**

UNIT -IV
EQUALIZATION AND DIVERSITY

1	a)	Explain about fundamentals of Equalization.	**[L2][CO4][6M]**
	b)	Explain the basic structure of an adaptive equalizer with neat diagram	**[L2][CO4][6M]**
2	a)	Derive the expression input covariance matrix for adaptive equalizer.	**[L2][CO1][6M]**
	b)	Rewrite the four matrix algebra rules used in the study of adaptive equalizers.	**[L2][CO1][6M]**
3	a)	Briefly explain equalizers in a communications receiver.	**[L2][CO1][6M]**
	b)	Consider the two-tap adaptive equalizer shown in Figure. (i) Find an expression for MSE in terms of w_0,w_1 and N (ii) If N>2, find the minimum MSE. 	**[L2][CO4][6M]**
4	a)	Explain linear transversal equalizer & lattice equalizer.	**[L2][CO3][6M]**
	b)	Explain Decision Feedback Equalization (DFE)	**[L2][CO2][6M]**
5	a)	Explain Maximum likelihood sequence estimation (MLSE) equalizer.	**[L2][CO3][6M]**
	b)	Evaluate the performance of adaptive equalization algorithm based on various factors	**[L4][CO3][6M]**
6	a)	What is zero forcing equalizer algorithm explain ?	**[L2][CO4][6M]**
	b)	Consider the design of the US Digital Cellular equalizer. If the carrier frequency is 900 MHz and the maximum Doppler shift is 66.67 Hz. (i) Calculate the maximum mobile velocity for the given Doppler Shift. (ii) Calculate the coherence time of the channel. (iii) Find the Doppler spread.	**[L4][CO5][6M]**
7	a)	Interpret Least Mean Square (LMS) Algorithm is the simplest equalization algorithm,	**[L3][CO4][6M]**
	b)	Consider the design of the US Digital Cellular equalizer. If the carrier frequency is 900 MHz and the maximum Doppler shift is 66.67 Hz. (i) Assuming that the symbol rate is 24.3 ksymbol/sec, Calculate the maximum number of symbols that can be transmiied without updating the equalizer. (ii) Assume that there are 5 delay elements in an equalizer and there are 10us delay in each, calculate the maximum number	**[L4][CO5][6M]**

		of taps. (iii)Calculate the maximum multipath delay spread that could be equalized.	
8	a)	Derive the expression for selection diversity improvement.	**[L3][CO4][6M]**
	b)	Assume five branch diversity is used, where each branch receives an independent Rayleigh fading signal. If the average SNR is 20 dB, determine the probability that the SNR will drop below 10 dB. Compute the mean SNR. Compare this with the case of a single receiver without diversity.	**[L3][CO5][6M]**
9	a)	Explain about selection diversity and feedback diversity	**[L2][CO4][6M]**
	b)	Explain about maximal ratio combining and equal gain diversity	**[L1][CO4][6M]**
10	a)	Describe about macro diversity and express the mathematical representation of macro diversity.	**[L2][CO4][6M]**
	b)	Explain about micro diversity in wireless communication.	**[L2][CO1][6M]**

UNIT –V
MULTIPLE ACCESS TECHNIQUESANDMULTIPLE ANTENNA TECHNIQUES

1	a)	Explain the multiple access scheme for narrowband systems and wideband systems	**[L2][CO1][6M]**
	b)	Describe the features of the frequency division multiple access (FDMA) scheme.	**[L2][CO1][6M]**
2	a)	Analyze the nonlinear effects in the frequency division multiple access (FDMA) scheme.	**[L4][CO1][6M]**
	b)	Find the intermodulation frequencies generated if a base station transmits two carrier frequencies at 1930 MHz and 1932 MHz that are amplified by a saturated clipping amplifier. If the mobile radio band is allocated from 1920 MHz to 1940 MHz, designate the IM frequencies that lie inside and outside the band.	**[L4][CO5][6M]**
3	a)	Describe the features of time division multiple access (TDMA) scheme.	**[L2][CO1][6M]**
	b)	A normal GSM has 3 start bits, 3 stop bits (also called as trailing bits), 26 training bits for allowing adaptive equalization, 8.25 guard bits and 2 bursts of 58 bits of encrypted data which is transmitted at 270.833 kbps in the channel. Find (i) Number of overhead bits per frame, boh (ii) Total number of bits/frame (iii) Frame rate (iv) Time duration of a slot (v) Frame efficiency	**[L4][CO5][6M]**
4	a)	Evaluate the efficiency of time division multiple access (TDMA) scheme.	**[L4][CO2][6M]**
	b)	In IS-95 CDMA system, if W= 1.25 MHz, R= 9600bps, and N=14 users (i) Calculate E_b/N_0 (ii) When no voice activity is there, calculate E_b/N_0 for omnidirectional antennas (iii) If voice activity = 3/8 and three sector antennas are used,	**[L4][CO3][6M]**

		calculate the total number of users cell.	
5	a)	Describe the features of code division multiple access (CDMA) scheme.	**[L2][CO1][6M]**
	b)	Explain various hybrid spread spectrum techniques in CDMA.	**[L2][CO3][6M]**
6	a)	Describe space division multiple access (SDMA) scheme.	**[L2][CO1][6M]**
	b)	Explain in detail packet radio schemes and packet radio protocols.	**[L3][CO5][6M]**
7	a)	Differentiate between Pure ALOHA and slotted ALOHA	**[L4][CO1][6M]**
	b)	Describe carrier sense multiple access (CSMA) protocols with various CSMA strategy.	**[L2][CO1][6M]**
8	a)	Describe MIMO systems. How does spatial multiplexing works?	**[L2][CO6][6M]**
	b)	Explain system model and channel state information for MIMO transmission.	**[L1][CO6][6M]**
9	a)	Explain the operation of precoding and beamforming schemes.	**[L1][CO6][6M]**
	b)	Illustrate transmit diversity and receive diversity with neat diagram.	**[L3][CO4][6M]**
10	a)	Explain capacity in non-fading channels.	**[L2][CO2][6M]**
	b)	Derive the expression for capacity in fading channels.	**[L3][CO2][6M]**

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