

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2171004

Date:25/01/2021

Subject Name:Wireless Communication

Time:10:30 AM TO 12:30 PM

Total Marks: 56

Instructions:

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) Give full forms of the following acronyms: WLAN, VoIP, AMPS.	03
	(b) Assume a 1 Amp-hour battery is used on a cellular telephone. Also, Assume that the cellular telephone draws 35 mA in idle mode and 250 mA during a call. Estimate the battery life for the following cases: (i) If the user leaves the phone on continually and has one 3-minute call every day. (ii) If the user leaves the phone on continually and has one 3-minute call every 6 hours. (iii) If the user leaves the phone on continually and has one 3-minute call every hour. (iv) Calculate the maximum talk time available on the phone in this example.	04
	(c) Draw a neat sketch of GSM architecture and state the functions of the following: BSC, MSC, VLR, HLR, AUC.	07
Q.2	(a) How the cell coverage radius would be affected by the system loading for each of the following technologies: AMPS-FDMA, IS-95 CDMA and IS-54 TDMA.	03
	(b) State the reason(s) for the IS-95 CDMA system to use rate $\frac{1}{2}$ convolution encoding in the forward channel and rate $\frac{1}{3}$ convolution encoding in the reverse channel.	04
	(c) Briefly discuss security threats in wireless network and suggest possible ways of protection.	07
Q.3	(a) A Wi-Fi system operates at 1 Mbps. Calculate the data transfer time required for a 20 KB file.	03
	(b) Compute the rms delay spread for the power delay profile in FIG.1. If BPSK modulation is used, what is the maximum bit rate that can be sent through the channel without needing an equalizer?	04

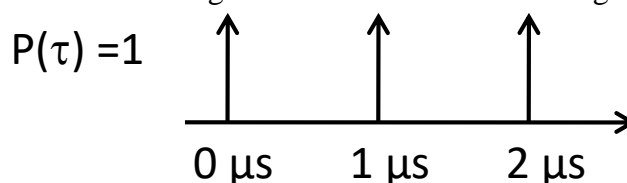


FIG.1

- (c) A spectrum of 30 MHz is allocated to a wireless FDD cellular 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) 4-cell reuse (ii) 7-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. **07**
- Q.4** (a) A Wi-Fi access point transmits +20 dBm power. The receiver sensitivity of a wireless device in the network is specified as -85 dBm. Determine the maximum allowable path loss, ignoring other power losses. **03**
- (b) In a digital cellular system, if $f_c = 900$ MHz and the mobile velocity is 60 km/hr, calculate the received carrier frequency if the mobile is (i) Directed towards the transmitter (ii) going away from the transmitter and (iii) moving in a direction which is perpendicular to the direction of the arrival of the transmitted signal. **04**
- (c) For given path loss exponent (A) $n=4$ and (B) $n=3$, find the frequency reuse factor and the cluster size that should be used for maximum capacity. The signal to interference ratio (S/I) is required to be at least 15 dB for satisfactory system performance. 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. **07**
- Q.5** (a) Calculate the change in received signal power in a mobile environment with path loss exponent $n=4$ at two different points such that the distance of the second point is two times the distance of the first point. Express your answer in dB. **03**
- (b) Explain salient features of CDMA. **04**
- (c) Consider two different cellular systems that share the following characteristics. The frequency bands are 825-845 MHz for uplink and 870-890 MHz for the downlink. A duplex circuit consists of one 30 kHz channel in each direction. The systems are distinguished by the reuse factor, which are 4 and 19 respectively. For these systems, (i) Find the maximum number of simultaneous conversations that can be supported by a single cell in each system. (ii) Suppose that in each systems the cluster of cells (4, 19) is duplicated 16 times, find the number of simultaneous conversations that can be supported by each system. Assume 8 TDMA slots/frame for each system. **07**
- Q.6** (a) Calculate the change in received signal power in a free-space propagation environment at two different points such that the distance of the second point is ten times the distance of the first point. Express your answer in dB. **03**
- (b) Discuss the frame efficiency of TDMA with apt equations. **04**
- (c) Prove that for a regular hexagonal geometry, the frequency reuse ratio and cluster size are related by the relationship $Q = (3N)^{1/2}$, where $N = i^2 + j^2 + ij$. **07**
- Q.7** (a) Explain briefly how a RAKE receiver improves the received signal strength. **03**

- (b) In the following cases, tell whether the two-ray model could be applied, and explain why or why not: 04
- Case 1: $h_t = 35$ m, $h_r = 3$ m, $d = 250$ m.
- Case 2: $h_t = 30$ m, $h_r = 1.5$ m, $d = 450$ m.
- (c) In a cellular radio operating at 800 MHz, the transmitter and the receiver are separated by 500m from each other. The knife-edge diffraction object between them has a height of 30 m. The diffraction object is 100 m from transmitter. Find: 07
- (i) The excess path length
 - (ii) The phase difference corresponding to the excess path length.
 - (iii) The Fresnel-Kirchhoff diffraction parameter.
 - (iv) The radius of the second Fresnel zone.
- Q.8** (a) List types of diversity techniques and explain any one of them in 3-4 sentences. 03
- (b) Define following terms: 04
- (i) Dwell time
 - (ii) Soft handoff
 - (iii) mobile assisted handoff
 - (iv) Transceiver
- (c) If a baseband binary message with a bit rate of 100 kbps is modulated by an RF carrier using BPSK. Calculate the following: 07
- (i) Find the range of values required for rms delay spread of the channel such that the received signal is a flat-fading signal.
 - (ii) If the modulation carrier frequency is 5.8 GHz, what is the coherence time of the channel for vehicle speed of 50 km/h.
 - (iii) For your answer in part (ii), is the channel “fast” or “slow” fading?
 - (iv) Given your answer in (ii), how many bits are sent while the channel appears static?
