Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

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

ELECTRONICS AND COMMUNICATION ENGINEERING

Semester VI

EC7702 / EC 5601 WIRELESS COMMUNICATION

(Regulation 2019)

Time: 3hrs Max.Marks: 100

CO 1	Ability to characterize the wireless channel & evolve system design specifications
CO 2	Ability to design cellular systems based on resource availability & traffic demands
CO 3	Ability to design & analyses suitable signaling schemes for fading channels
CO 4	Ability to evaluate multipath mitigation technique for wireless channel & system under consideration
CO 5	Ability to apply & evaluate the multiple antenna concepts for capacity & performance gains

BL – Bloom's Taxonomy Levels

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	What is the minimum close-in-reference distance for an antenna with maximum dimension of 30 cm operating at a frequency of 1800 MHz ?	2	1	3
2	Define receiver sensitivity and brief on how it impacts the RF link budget and the link outage.	2	1	2
3	Differentiate between hard handoff and soft handoff.	2	2	2
4	If the SIR required is 15 dB for a six sector base station, in an environment with path loss exponent = 4, what could be the possible reuse factor ?.	2	2	3
5	Compare the signal constellations of QPSK and π /4 QPSK modulations.	2	3	3
6	What is PAPR and how it affects the overall system performance? List any two methods that can be used to reduce PAPR.	2	3	4
7	How is Switched Diversity combining technique different from the Selection Diversity combining technique?	2	4	2
8	What is the principle of operation of an equalizer and how does it improve received signal quality ?	2	4	4
9	Define Shannon's Capacity and Outage capacity for the MIMO system. Assume CSI is not available at the transmitter.	2	5	2
10	Differentiate between Spatial Multiplexing and Spatial Diversity in MIMO systems.	2	5	2

PART- B (5 x 13 = 65 Marks)

(Restrict to a maximum of 2 subdivisions)

<table>
<tr><th>Q. No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>11 (a)</td><td>Distinguish between large scale fading and small scale fading. Explain with suitable diagrams and derivation the two - ray ground reflection model for path loss prediction and highlight the conditions in which this model can be used in estimating the path loss.</td><td>13</td><td>1</td><td>2</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>11 (b)</td><td>Explain the small scale parameters Coherence bandwidth, Coherence Time, RMS delay spread and Doppler spread. How do you classify mobile multipath channels based on the above parameters.</td><td>13</td><td>1</td><td>2</td></tr>
<tr><td>12 (a)</td><td>A city has an area of 1300 square miles and is covered by a cellular system using a seven-cell reuse pattern. Each cell has a radius of 4 miles and the city is allocated 40 MHz of spectrum with full duplex channel bandwidth of 60 KHz. Assume, a GOS of 2% for an Erlang B system is specified. On an average each user generates calls at the rate of 1 per hour with an average call holding time of 1.8 minutes. Compute (a) the number of cells in the service area, (b) the number of channels available per cell, (c) traffic intensity supported by each cell, (d) the maximum carried traffic, (e) the total number of users that can be served for 2% GOS, (f) the number of mobiles per unique channel , and (g) the theoretical maximum number of users that could be served at one time by the system Use the following Erlang B table..
<table>
<tr><td>No. of trunked channels</td><td>70</td><td>75</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr>
<tr><td>Traffic Intensity in Erlangs for 2 % blocking</td><td>60</td><td>67</td><td>70</td><td>76</td><td>80</td><td>84</td><td>90</td></tr>
</table></td><td>13</td><td>2</td><td>3</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>12 (b)</td><td>Assume a particular FDD cellular system having 100 full duplex channels per cell in a four-cell reuse configuration. Each user generates on an average 2 calls/hour and the average call duration is 3 minutes in a blocked calls cleared trunking system. If each cell is to offer a capacity that is 90% of perfect scheduling, (i) find the maximum number of users that can be supported per cell where omnidirectional antennas are used at all base stations, (ii) What is the probability of blocking for the above, (iii) If 120° sectoring is used by all base stations instead of omnidirectional antennas, what would be the total number of users supported in a cell for same blocking performance. (iv) How many subscribers are supported in an urban market of 50 km x 50 km, for both cases, if each cell covers an area of 5 sq. km.</td><td>13</td><td>2</td><td>3</td></tr>
</table>

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	No. of trunked channels	30	40	50	60	70	80	90	100			
	Traffic Intensity in Erlangs for 2 % blocking	22	31	40	50	59	68	79	87			
	Traffic Intensity in Erlangs for 3 % blocking	24	33	43	52	61	70	80	90			
	Traffic Intensity in Erlangs for 4 % blocking	25	34	44	53	63	74	84	94			
13 (a) (i)	Explain the π/4 - DPSK modulator and demodulator.									**8**	**3**	**2**
(ii)	Determine the transmitted in-phase and quadrature-phase for the bit sequence 101110, considering π/4 - DPSK modulation. Assume the Initial phase is equal to zero. Also demonstrate suitable detection technique to detect the symbol at receiver.									**5**	**3**	**3**
	OR											
13 (b) (i)	Explain the need for (i) Cyclic prefix and (ii)Windowing, in OFDM Systems.									**8**	**3**	**2**
(ii)	Given an OFDM system with the following specifications: OFDM FFT symbol period = 4 micro sec, Cyclic prefix duration = 0.8 micro sec, Band width B = 20 MHz and modulation Scheme = 64QAM. Determine the numbers of subcarriers possible and the maximum bit rate that can be transmitted.									**5**	**3**	**3**
14 (a) (i)	Differentiate between linear and non-linear equalization. Explain with suitable diagrams one example for each.									**10**	**4**	**3**
(ii)	What is the relationship between the RMS delay spread and delay spacing on the number of taps needed for a tapped delay-line equalizer ?									**3**	**4**	**4**
	OR											
14 (b) (i)	Explain the Maximal Ratio Combiner based diversity combining strategy and also show how this concept is applied in a RAKE receiver.									**10**	**4**	**3**
(ii)	How is the delay spread of the channel related to the minimum spacing between frequencies to be considered in frequency diversity ?									**3**	**4**	**4**
15 (a) (i)	Explain how the Water Filling algorithm is used in improving the capacity of a MIMO system for a deterministic channel assuming the channel state information (CSI) is available at the transmitter.									**13**	**5**	**3**
	OR											
15 (b) (i)	Explain the coding and decoding process involved in Alamouti Coding scheme considering a 2 x 2 MIMO system.									**13**	**5**	**3**

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16. (i)	What is the difference between Duplexing and Multiplexing ? Elaborate on the combinations of Duplexing / Multiple Access methods that are adopted in 1G, 2G, 3G and 4G cellular communication systems for capacity enhancement.	6	2	5
(ii)	Estimate and compare the user capacity of the AMPS, GSM and CDMAOne cellular systems with following specifications. Total spectrum band available = 25 MHz Total number of cells in the region with Omnidirectional Base station coverage = 100 SIR requirements : • 18 dB for AMPS, 14 dB for GSM • CDMA based system uses N = 1 Assume the following: • Data rate R = 9.6 Kbps for GSM/CDMAOne For CDMA system the required E_b/N_o = 6 dB, other cell interference factor = 0.5, power control accuracy = 85 %, voice activity factor v = 60%	9	2	5

THE END