DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT : EC6801 – WIRELESS COMMUNICATION

YEAR /SEM: IV /VIII

	UNIT – I WIRELESS CHANNELS		
	Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.		
	PART – A		
Q. No.	**Questions**	**BT Level**	**Competence**
1	List the different types of propagation mechanisms.	BTL 1	Remembering
2	Illustrate the Friis free space equation.	BTL 2	Understanding
3	State Snell's law.	BTL 1	Remembering
4	Analyze the two types of propagation model.	BTL 4	Analyzing
5	Model the Fraunhofer distance for an antenna with maximum dimension of 1m and operating frequency of 900 MHz. If antenna has unity gain, calculate the path loss.	BTL 6	Creating
6	Interpret Link budget equation.	BTL 3	Applying
7	Outline the features of multipath propagation.	BTL 1	Remembering
8	Examine the features of scattering. Why does it occur ?	BTL 3	Applying
9	State the differences between small scale fading and large scale fading.	BTL 1	Remembering
10	Analyze the Doppler effect in the wireless channel.	BTL 4	Analyzing
11	Classify the fading effects in mobile radio channel due to Doppler Spread.	BTL 2	Understanding
12	Define coherence bandwidth.	BTL 1	Remembering
13	Discuss about the parameter Coherence. In what way does this parameter decide the behaviour of wireless channel ?	BTL 5	Evaluating
14	Enumerate the factors influencing the small scale fading.	BTL 4	Analyzing
15	Summarize the impact of fading in wireless communication.	BTL 5	Evaluating
16	Write about mean excess delay and rms delay spread.	BTL 1	Remembering
17	Examine the variations of channel behaviour due to frequency flat and frequency selective fading in wireless Communication.	BTL 2	Understanding

18	Generalize the effect of fading in wireless channel due to Doppler spread.	BTL 6	Creating
19	Exhibit the differences between fast fading channel and slow fading channel.	BTL 3	Applying
20	Explore the Rayleigh and Ricean fading distribution used to denote behaviour of the wireless channel.	BTL 2	Understanding

PART – B

Q. No.	Questions		BT Level	Competence
1	(i) Relate the signal propagation against free space attenuation and reflection. (ii) Describe in detail two ray propagation mechanisms.	(6) (7)	BTL 1	Remembering
2	Explain in brief about the three propagation mechanisms which have impact on propagation in a mobile environment.	(13)	BTL 1	Remembering
3	(i) Explore the advantages and disadvantages of the two-ray ground reflection model in the analysis of path loss. (ii) Examine the following cases and infer whether the two-ray model could be applied, and justify why or why not: Case (i) h1 = 35m , hr = 3m, d = 250m Case (ii) h1 = 30m , hr= 1.5m , d = 450m	(6) (7)	BTL 3	Applying
4	Assume if a transmitter produces 50W of power, express the transmit power in units of dBm and dBW. If 50W is applied to a unity gain antenna with a 900 MHz carrier frequency, find the received power in dBm at a free space distance of 100m from the antenna also justify the analytical expression by computing the the received power at 10km.	(13)	BTL 6	Creating
5	(i)With system theoretic description, explain the characteristics of time dispersive channels. (ii) Find the far field distance for an antenna with maximum dimension of 1m and operating frequency of 500 MHz.	(6) (7)	BTL 4	Analyzing
6	(i) How would you explain fading effects due to multipath time delay spread and fading effects due to Doppler spread? (ii)Name and explain the factors influencing small scale fading.	(7) (6)	BTL 1	Remembering
7	(i)Summarize the following (a) Doppler shift, (b) Doppler spread, (c) Coherence time, (ii)Calculate the Doppler spread if the carrier frequency is 1900 MHz and velocity is 50 m/s.	(9) (4)	BTL 5	Evaluating
8	Exhibit the various parameters involved in mobile multipath channels and explain in detail.	(13)	BTL 4	Analyzing
9	(i)Analyze the process to achieve a balanced link budget within a given cell size. (ii)Enumerate the characteristics of coherence bandwidth and compare with signal bandwidth in wireless channel.	(7) (6)	BTL 4	Analyzing

10	(i)Categorize what are the factors that influence small-scale fading. (ii)Consider a transmitter which radiates a sinusoidal carrier frequency of 1850 MHz. For a vehicle moving 60 mph, compute the received carrier Frequency if the mobile is moving directly toward the transmitter. (iii)Given that the coherence bandwidth is approximated by equation $B_c = \frac{1}{5\sigma_\tau}$. Demonstrate that a flat fading channel occurs when $T_s \geq 10\sigma_\tau$.	(5) (4) (4)	BTL 3	Applying
11	Classify the small scale fading in wireless channel based on multipath time delay spread.	(13)	BTL 2	Understanding
12	Illustrate the types of fading experienced by the signal as a function of symbol period (Ts) and baseband signal bandwidth (Bs)	(13)	BTL 2	Understanding
13	Mention the distribution that describes the statistical time varying behavior of the received signal in mobile radio channel.	(13)	BTL 1	Remembering
14	Discuss in detail about fast fading and slow fading in wireless channel and explain in detail.	(13)	BTL 2	Understanding

PART-C

1.	(i)Assess why large-scale and small-scale fading occur in wireless systems. (ii)"In practice fast fading only occurs for very low data rate (communications)". Justify.	(8) (7)	BTL 5	Evaluating
2	(i)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 10m travel distance if fc =1900 MHz and v=50m/s. How long would it take to make these measurements, assuming they could be made in real time from a moving vehicle? What is the Doppler spread BD for the channel? (ii)Formulate the parameters of mobile multipath channels with their significance.	(7) (8)	BTL 6	Creating
3	(i)Consider two different wireless systems a and b. For a, the signal bandwidth of the system is much smaller than the coherence bandwidth of the channel. Conversely, b employs a signal bandwidth that is much larger than the coherence bandwidth of the channel. Which system (a or b) is best suited for employing frequency diversity techniques? (ii)Derive the path loss considering a Two-Ray Model for the propagation mechanism in a wireless channel. Is considering just two rays alone sufficient? why?	(7) (8)	BTL 6	Creating
4	Evaluate the length and effective aperture of the effective the receiving antenna for a mobile is located at 5Kms away from base station and uses a vertical λ/4 monopole antenna with a gain of 2.55 dB to receive cellular radio signals. The E-field at	(15)	BTL 5	Evaluating

	1Km from transmitter is measured to 10^{-3}V/m the carrier frequency is 900 MHz. Also 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 1.5 m above the ground.			STUCOR APP

	UNIT – II CELLULAR ARCHITECTURE		
	Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.		
	PART – A		
Q. No.	**Questions**	**BT Level**	**Competence**
1.	State the advantages of CDMA over FDMA.	BTL1	Remembering
2.	What are the effects of multipath propagation on CDMA?	BTL1	Remembering
3.	Define frequency re-use ratio.	BTL1	Remembering
4.	List the different types of multiple access schemes.	BTL1	Remembering
5.	Illustrate co-channel reuse ratio.	BTL3	Applying
6.	Summarize about cell and shapes related to cell..	BTL2	Understanding
7.	Compare and contrast FDMA, CDMA and TDMA.	BTL4	Analyzing
8.	Explain channel assignment.	BTL2	Understanding
9.	Demonstrate the importance of cell splitting and sectoring in networks.	BTL3	Applying
10.	Illustrate how you would apply frequency reuse technique.	BTL2	Understanding
11.	Mention the importance of frequency reuse in cellular networks.	BTL5	Evaluating
12.	Write about forward and reverse channel.	BTL3	Applying
13.	Compare co channel interference and adjacent channel interference.	BTL2	Understanding
14.	Differentiate between Soft and hard handoff in mobile communication.	BTL1	Remembering
15.	How will you find Trunking and Grade of Service?	BTL1	Remembering
16.	Assess the theme of blocked call delay systems.	BTL4	Analyzing
17.	Analyse 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. Compute the number of channels available per cell if it uses 4 cell reuse.	BTL4	Analyzing
18.	Interpret signal-interference ratio.	BTL5	Evaluating
19.	Build microcell zone concept and list their advantages.	BTL6	Creating
20.	Discuss a few techniques used to improve the coverage and capacity of cellular systems.	BTL6	Creating

	PART – B			
Q. No.	**Questions**		**BT Level**	**Competence**
1.	(i) Illustrate multiple access techniques (a)TDMA, (b)FDMA, (c)CDMA, (ii) Compare various multiple access techniques with each other.	 (3) (3) (3) (4)	BTL2	Understanding
2.	Explain in detail about the following (i) Cellular network architecture. (ii) How frequency is efficiently allocated in a cellular radio systems.	 (8) (5)	BTL2	Understanding
3.	Identify and Explain the channel capacity of TDMA in cell system in detail.	(13)	BTL4	Analyzing
4.	Give detailed note about system capacity of cellular system.	(13)	BTL1	Remembering
5.	(i) Write about frequency reuse concept. (ii) Explain in detail about channel assignment strategies.	(7) (6)	BTL3	Applying
6.	(i) Discuss a cellular service provider that decides to use a digital TDMA scheme which can tolerate a signal –to-interference ratio of 15dB in the worst case. Find the optimal value of N for (1) Omni directional antennas (2) 120° sectoring (3) 60° sectoring (4) Should sectoring be used? If so, which case (120°or 60°) should be used? (Assume a path loss exponent of n=4 and consider trunking efficiency? (ii) If signal-to-interference ratio of 15dB is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent is (1) n=4 (2) n=3?	 (3) (2) (2) (3) (3)	BTL6	Creating
7.	(i) Summarize the features of various multiple access technique used in wireless mobile communication. (ii) State the advantages and disadvantages of multiple access techniques.	(9) (4)	BTL2	Understanding
8.	A hexagonal cell within a four cell system has a radius of 1.387km. A total of 60 channels are used within the entire system. If the load per user is 0.029 Erlangs, and λ=1 call/hour, compute the following for an Erlang C system that has a 5% probability of a delayed call and determine the following, (i) How many users per square kilometre will this system support? (ii) What is the probability that a delayed call will have to wait for more than 10sec? (iii) What is the probability that a call will be delayed for more than 10sec?	 (3) (4) (6)	BTL5	Evaluating
9.	How to select various techniques to improve coverage and channel capacity in cellular systems? Explain each in detail.	(13)	BTL1	Remembering
10.	What is interference and system capacity and explain in detail with neat diagram?	(13)	BTL1	Remembering

11.	Demonstrate the handoff strategies in detail.	(13)	BTL3	Applying
12.	Examine the co-channel interference and adjacent channel interference. Describe the techniques to avoid interference.	(13)	BTL4	Analyzing
13.	Analyze the concept of (i) Repeaters for range extension. (ii) Microcell zone concept.	(7) (6)	BTL4	Analyzing
14.	Write short notes on (i) Trunking. (ii) Grade of service of cell system.	(7) (6)	BTL1	Remembering
	PART C			
1.	(i) Elaborate spread spectrum multiple access techniques. (ii) Consider Global System for Mobile, which is a TDMA/FDD system that uses 25 MHz for the forward link, which is broken into radio channels of 200 MHz. If 8 speech signals are supported on a single radio channel and if no guard band is assumed find the number of simultaneous users that can be accommodated in GSM.	(10) (5)	BTL 6	Creating
2.	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 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.	(15)	BTL 5	Evaluating
3.	(i) Discuss about Grade of service of cell system. (ii) Estimate that how many users can be supported for 0.5% blocking probability for the following number of trunked channels in a blocked calls cleared system? (a) 1, (b) 5,(c) 10,(d) 20,(e) 100. Assume each user generates 0.1 Erlangs of traffic.	(9) (6)	BTL 6	Creating
4.	Assess the techniques to improve coverage and capacity.	(15)	BTL 5	Evaluating

UNIT – III DIGITAL SIGNALING FOR FADING CHANNELS

Structure of a wireless communication link, Principles of Offset-QPSK, π/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

PART – A

Q. No.	Questions	BT Level	Competence
1.	Show the structure of wireless communication link.	BTL 3	Applying
2.	Give the function of Gaussian filter in GMSK.	BTL 1	Remembering

3.	Write about QPSK and π/4 differential QPSK.	BTL 3	Applying
4.	Analyse and list any two criteria for choosing a modulation technique for a specific wireless communication.	BTL 4	Analyzing
5.	List the advantages of OQPSK.	BTL 1	Remembering
6.	How would you explain non coherent detection?	BTL 1	Remembering
7.	Discuss about the features of QPSK.	BTL 2	Understanding
8.	Identify bit error rate of GMSK.	BTL 1	Remembering
9.	Differentiate between MSK and GMSK.	BTL 2	Understanding
10.	Why is MSK referred to as fast FSK?	BTL 3	Applying
11.	Examine the term Bandwidth efficiency.	BTL 4	Analyzing
12.	Analyze the importance of constellation diagram. What do you infer from it?	BTL 4	Analyzing
13.	Assess the importance of a Gaussian filter in GMSK	BTL 5	Evaluating
14.	Develop the constellation diagram of offset QPSK.	BTL 6	Creating
15.	Review the features of OFDM.	BTL 2	Understanding
16.	What do you mean by cyclic prefix?	BTL 1	Remembering
17.	Define the concept of windowing.	BTL 1	Remembering
18.	Interpret the term PAPR with necessary equations.	BTL 2	Understanding
19.	Measure the 3-dB bandwidth for a Gaussian low pass filter used to produce 0.25 GMSK with a channel data of R_b=300 kbps.	BTL 5	Evaluating
20.	A 900 MHz carrier signal is frequency modulated using a 100 kHz sinusoidal modulating waveform. The peak deviation of the FM signal is 500 kHz. If this FM signal is received by a super heterodyne receiver having frequency of 5 MHz, determine the IF bandwidth necessary to pass the signal.	BTL 6	Creating

PART – B

Q. No.	Questions		BT Level	Competence
1.	(i) Explain about the modulation technique of QPSK with neat diagram. (ii) List the advantages and disadvantages QPSK.	(10) (3)	BTL 1	Remembering
2.	(i) Describe the modulation and demodulation of π/4 QPSK and its advantages with neat block diagram. (ii) What is MSK? Explain its power spectral density.	(8) (5)	BTL 1	Remembering
3.	How would you describe the generation and demodulation of Minimum Shift Keying (MSK) signals? Explain in detail?	(13)	BTL 1	Remembering
4.	What is flat fading channels? Derive the expression for probability of error in flat fading channels.	(13)	BTL 1	Remembering
5.	Explain in detail about Gaussian Minimum Shift Keying (GMSK) transmission and reception with necessary block diagram.	(13)	BTL 2	Understanding
6.	Illustrate the expression for the bit error rate for binary phase shift keying modulation for frequency flat fading channels.	(13)	BTL 2	Understanding
7.	Interpret the structure of a wireless communication link in detail.	(13)	BTL 2	Understanding
8.	(i) Construct the circuits for the generation, deduction and of DQPSK scheme. (ii) A zero mean sinusoidal message is applied to a transmitter that radiates an AM signal with 10KW power. Compute the carrier power if the modulation index is 0.6. What percentage of the total power is in the carrier? Calculate the power in each sideband.	(8) (5)	BTL 3	Applying

9.	Derive the expression for bandwidth and power spectral density of digital signals.	(13)	BTL 3	Applying
10.	(i) Analyze the performance of digital modulation in slow flat fading channels. (ii) List the functions of PAPR in OFDM systems.	(8) (5)	BTL 4	Analyzing
11.	(i) What is the principle of OFDM systems and explain its operation with neat block diagram. (ii) Distinguish between windowing and PAPR.	(8) (5)	BTL 4	Analyzing
12.	(i) Examine the function of cyclic prefix and explain the performance of frequency selective channels? (ii) Compare the modulation techniques QPSK and GMSK.	(8) (5)	BTL 4	Analyzing
13.	Evaluate the expression for probability of error in frequency dispersive fading channels.	(13)	BTL 5	Evaluating
14.	Design a delay dispersive and frequency dispersive fading channels and formulate an expression for the error probability.	(13)	BTL 6	Creating
PART – C				
1.	Why are constant envelope modulation schemes such as MSK and GMSK used in a wireless communication system? Compare and contrast these two modulation techniques.	(15)	BTL 5	Evaluating
2.	Assess the fading channel models and its performance in wireless communication.	(15)	BTL 6	Creating
3.	Summarize the effects of High Peak-to-Average Power Ratio (PAPR) of the transmitted signal and assess the PAPR reduction methods	(15)	BTL 5	Evaluating
4.	Discuss about OFDM system converts the delay spread channel into a set of parallel fading channels using the concept of cyclic prefix.	(15)	BTL 6	Creating

UNIT – IV MULTIPATH MITIGATION TECHNIQUES

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

PART – A

Q. No	Questions	BT Level	Competence
1.	What is the need of equalization?	BTL 1	Remembering
2.	Can you brief the principle of diversity?	BTL 1	Remembering
3.	Define zero forcing equalizer.	BTL 1	Remembering
4.	Recall the merits of Space Diversity Schemes.	BTL 1	Remembering
5.	List the factors used in the selection of adaptive equalizers.	BTL 1	Remembering
6.	Realize the two main modes in in adaptive algorithms.	BTL 1	Remembering
7.	Compare between LMS and RMS algorithm.	BTL 2	Understanding
8.	Outline the advantages of LMS algorithm.	BTL 2	Understanding
9.	Express the prediction error measured in linear equalizer during training process.	BTL 2	Understanding
10.	How least mean square algorithm is used in equalization techniques?	BTL 2	Understanding
11.	If a digital signal processing chip perform one million multiplications as per second, determine the time required between each iteration for the following adaptive equalizer algorithms.	BTL 3	Applying

12.	Classify the diversity and its combining techniques.	BTL 3	Applying
13.	Obtain the transfer function of linear predictive coder.	BTL 3	Applying
14.	Compare and contrast linear equalizers and nonlinear equalizers.	BTL 4	Analyzing
15.	Examine the VSELP coder in speech signal transmission.	BTL 4	Analyzing
16.	Analyse the causes for the degradation in BER performance.	BTL 4	Analyzing
17.	Obtain the principles of maximum ratio combining and equal gain combining.	BTL 5	Evaluating
18.	Why nonlinear equalizers are preferred? Justify.	BTL 5	Evaluating
19.	State the significance of RAKE receiver.	BTL 6	Creating
20.	Design the linear transversal equalizer structure.	BTL 6	Creating

PART - B

Q. No.	Questions		BT Level	Competence
1.	How would you describe the following, (i) Linear Equalizers, (ii) Non-linear equalizers.	 (7) (6)	BTL 1	Remembering
2.	(i) Describe about adaptive equalizer used for receiver. (ii) Define zero forcing equalizer and derive the mean square error criteria.	(7) (6)	BTL 1	Remembering
3.	(i) Sketch the Decision feedback equalizer block diagram and explain its working principle. (ii) What is decision feedback equalizer and derive an expression for its minimum mean square error.	(7) (6)	BTL 1	Remembering
4.	(i) Explain the factors influencing in the selection of algorithm for AE. (ii) Describe the two modes of operating methods in adaptive equalizers.	(7) (6)	BTL 1	Remembering
5.	(i) Describe about RLS algorithms with necessary equations. (ii) Express the LMS algorithm for an adaptive equalizer.	(7) (6)	BTL 2	Understanding
6.	Illustrate the following, (i) Spatial Diversity. (ii) Polarization Diversity.	 (7) (6)	BTL 2	Understanding
7.	Discuss the principle of diversity and various diversity schemes with their advantages and disadvantages.	(13)	BTL 2	Understanding
8.	Examine the different types of diversity techniques and explain Time, Frequency and Angular diversity techniques.	(13)	BTL 3	Applying
9.	Classify the two main algorithms used under linear equalizers and explain them in detail.	(13)	BTL 3	Applying
10.	Analyze various diversity techniques used in wireless communication.		BTL 4	Analyzing
11.	Explain macro diversity. Obtain the RSSI and BER in selection diversity.	(13)	BTL 4	Analyzing
12.	Describe the error performance in fading channel and obtain the canonical receiver structure.	(13)	BTL 4	Analyzing
13.	Explain combining techniques using combination of signal, (i) Maximum ratio combining, (ii) Equal gain combining,	 (5) (4)	BTL 5	Evaluating

	(iii) Hybrid selection -maximum ratio combining.	(4)		STUCOR APP
14.	Elaborate Rake receiver with relevant diagrams. Also discuss how time diversity is achieved in a CDMA technique using Rake receiver.	(13)	BTL 6	Creating
	PART – C			
1.	With valid statements, analytically prove that the adaptive equalizers exhibit superior performance over the conventional equalizers.	(15)	BTL 5	Evaluating
2.	Consider a single branch Rayleigh fading signal has a 20% chance of being 6 dB below some mean SNR threshold. (i) Determine the mean of the Rayleigh fading signal as referenced to the threshold. (ii) Find the likelihood that a two branch selection diversity receiver will be 6 dB below the mean SNR threshold. (iii) Find the probability for three and four branches selection. (iv) Based on the above answers, is there a law of diminishing returns when diversity is used?	 (4) (4) (4) (3)	BTL 5	Evaluating
3.	(i) Design a Rake receiver with many correlators to separately detect multiple strongest components. (ii) Derive an expression for error probability in flat-fading channel.	(8) (7)	BTL 6	Creating
4.	Describe the role played by equalization and diversity as multipath mitigation techniques. Compare and contrast these two techniques.	(15)	BTL 6	Creating

UNIT – V MULTIPLE ANTENNA TECHNIQUES

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming – transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

PART - A

Q. No.	Questions	BT Level	Competence
1.	What are the advantages of MIMO systems?	BTL 1	Remembering
2.	Define MIMO Systems.	BTL 1	Remembering
3.	List the different types of schemes under multiple antenna systems.	BTL 1	Remembering
4.	How would you explain the limitations in wireless channels?	BTL 1	Remembering
5.	Identify the requirements of beam forming.	BTL 1	Remembering
6.	Outline the working of spatial multiplexing.	BTL 1	Remembering
7.	Distinguish between diversity gain and beam forming gain.	BTL 2	Understanding
8.	Summarize about the requirement for precoding.	BTL 2	Understanding
9.	Interpret the capacity of fading channel with noisy information.	BTL 2	Understanding
10.	Discuss on the discrete time channel model expression.	BTL 2	Understanding
11.	Demonstrate the characterization of single user capacity with CSI	BTL 3	Applying
12.	Describe two types of precoding.	BTL 3	Applying
13.	Illustrate the channel state information. What is the benefit of it?	BTL 3	Applying
14.	Specify about the characteristics of SDMA system.	BTL 4	Analyzing
15.	Analyze why perfect adaptive antennas are practically not possible.	BTL 4	Analyzing
16.	Examine CSI with respect to channel properties of a communication link.	BTL 4	Analyzing

17.	Discriminate the complex baseband representation of received signal expression.	BTL 5	Evaluating
18.	Assess the methods to increase the capacity of wireless system, without increasing required spectrum.	BTL 5	Evaluating
19.	Develop multi user MIMO systems.	BTL 6	Creating
20.	Create the structure of a MIMO system model.	BTL 6	Creating

PART - B

Q. No.	Questions		BT Level	Competence
1.	What is meant by MIMO systems? Describe the MIMO system model with necessary diagrams in detail.	(13)	BTL 1	Remembering
2.	(i)Explain the operation of spatial multiplexing with spot beams and capacity of cellular. (ii)Define precoding and explain the operation of transmit precoding.	(6) (7)	BTL 1	Remembering
3.	Why beamforming is important for wireless systems? Write short notes on transmit diversity.	(13)	BTL 1	Remembering
4.	Quote on diversity and explain STC and bandwidth efficiency.	(13)	BTL 1	Remembering
5.	(i) Discuss on Channel State Information to transmitter. (ii) Explain on Channel State Information at the receiver.	(7) (6)	BTL 2	Understanding
6.	Describe the capacity of a fading and non-fading channel for information transmitted from a wireless system.	(13)	BTL 2	Understanding
7.	Interpret channel state information and explain the different kinds of channel state information.	(13)	BTL 2	Understanding
8.	Illustrate on selection diversity and equal ratio combining.	(13)	BTL 3	Applying
9.	Demonstrate the coding And decoding schemes in channels and plot the average SNR Vs C/B.	(13)	BTL 3	Applying
10.	Compare the capacity of fading and non-fading channel for information transmitted from wireless system.	(13)	BTL 4	Analyzing
11.	Analyze on the receiver diversity and combination of signals.	(13)	BTL 4	Analyzing
12.	Explain in detail maximal ratio combiner technique and its advantages.	(13)	BTL 4	Analyzing
13.	Evaluate the system model and precoding for multi-user MIMO systems.	(13)	BTL 5	Evaluating
14.	(i)Discuss in detail on the classification of the BS antenna configuration. (ii)Explain the concept of water filling/pouring.	(6) (7)	BTL 6	Creating

PART - C

1.	Assess the fading and non fading channel with respect to capacity and discuss each in detail.	(15)	BTL 5	Evaluating
2.	Formulate the expression for performance improvement due to maximal ratio combining.	(15)	BTL 6	Creating
3.	Determine the capacity of slow fading channel and obtain the outage probability for receive diversity system with L receive antennas.	(15)	BTL 5	Evaluating
4.	(i) Elaborate the different types of diversity technique. Explain each in detail. (ii) Discuss the concept of multiplexing in spatial domain.	(8) (7)	BTL 6	Creating