SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

VII SEMESTER

1906703 - WIRELESS COMMUNICATION

Regulation – 2019

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SUBJECT : 1906703 – WIRELESS COMMUNICATION

YEAR /SEM : IV/VII

	UNIT – I CELLULAR ARCHITECTURE		
	Multiple Access techniques - FDMA, TDMA, CDMA – Packet Radio, Capacity calculations– The Cellular concept- Frequency reuse – Channel assignment strategies, Hand off strategies, Interference and System Capacity –CCI & ACI. Trunking & Grade of service – Methods to improve Coverage and Capacity in cellular systems.		
	PART – A		
Q. No.	**Questions**	**BT Level**	**Competence**
1	What is multiple access technique?	BTL1	Remembering
2	State the advantages of CDMA over FDMA.	BTL1	Remembering
3	How CDMA handle near far problem.	BTL1	Remembering
4	Compare and contrast FDMA and TDMA.	BTL4	Analyzing
5	Define frequency re-use ratio.	BTL1	Remembering
6	List the different types of multiple access schemes.	BTL1	Remembering
7	Give the expression for system capacity using frequency reuse.	BTL2	Understanding
8	Why the hexagon is used as a cell shape?.	BTL4	Analyzing
9	Summarize the different modules of a basic cellular system.	BTL2	Understanding
10	Mention the importance of frequency reuse in cellular networks.	BTL3	Applying
11	Illustrate how you would apply frequency reuse technique?	BTL2	Understanding
12	Define handoff process.	BTL1	Remembering
13	How does the handoff threshold minimize the call dropping probability?.	BTL3	Applying
14	Assess the requirement of channel assignment strategies. And how would you classify.	BTL4	Analyzing
15	Compare co channel interference and adjacent channel interference.	BTL2	Understanding
16	Differentiate between fixed channel and dynamic channel assignment strategies.	BTL3	Applying
17	Demonstrate the importance of cell splitting and sectoring in networks.	BTL3	Applying

18	Develop 60° and 120° cell sectoring in cellular networks.	BTL3	Applying
19	How will you find Trunking and Grade of Service?	BTL4	Analyzing
20	Mention the two types of trunked systems.	BTL4	Analyzing
21	Assess the theme of blocked call delay systems.	BTL4	Analyzing
22	Write Erlang B formula. How does it determine the GoS.	BTL2	Understanding
23	Explain a few techniques used to improve the coverage and capacity of cellular systems.	BTL2	Understanding
24	How does the microcell zone concept improve the system capacity?	BTL3	Applying

PART – B

Q. No.	Questions		BT Level	Competence
1	Define multiple access techniques and Compare various multiple access techniques with each other.	(13)	BTL1	Remembering
2	Explain in detail about the following (i) Cellular network architecture. (ii) How frequency is efficiently allocated in a cellular radio system.	 (7) (6)	BTL2	Understanding
3	(i) Identify the advantage of capacity calculation (ii) Explain the channel capacity of TDMA in cell system in detail.	(3) (10)	BTL1	Remembering
4	How would you explain the importance of capacity calculation in cellular system and narrate the methods to achieve it?	(13)	BTL2	Understanding
5	(i) Write about frequency reuse concept. (ii) Derive the frequency reuse factor of a cellular system.	(5) (8)	BTL3	Applying
6	(i) Explain in detail about channel assignment strategies. (ii) Tabulate the difference between fixed channel and dynamic channel assignment techniques.	(5) (8)	BTL3	Applying
7	Summarize the features of various multiple access technique used in wireless mobile communication and also state the advantages and disadvantages of multiple access techniques.	(13)	BTL2	Understanding
8	Obtain the expression of signal to interference ratio for the worst case of first tier of co-channel.	(13)	BTL2	Understanding
9	(i) List out the techniques to improve coverage and channel capacity in cellular systems? (ii) Explain the capacity improvement techniques in detail.	(3) (10)	BTL1	Remembering
10	Explain the interference concepts with suitable diagrams and mention the drawbacks of interference.	(13)	BTL1	Remembering
11	What would result if handoff strategies involved in cellular systems? Explain in detail.	(13)	BTL3	Applying
12	(i) Compare co-channel interference with adjacent channel interference. (ii) Describe the techniques to avoid co-channel interference.	(7) (6)	BTL4	Analyzing
13	Analyse 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
15	(i) Illustrate the concept of cell splitting (ii) Compare and contrast TDMA and CDMA	(7) (6)	BTL4	Analyzing
16	How is handoff in a cellular system implemented. Explain the different types of handoffs.	(13)	BTL4	Analyzing
17	Apply the concept of blocked calls delay and blocked calls cleared system to measure the GoS in trunked system.	(13)	BTL3	Applying

PART-C

1.	(i) Explain spread spectrum multiple access techniques. (ii) For the given path loss n=3, find the frequency reuse factor and the cluster size that should be used for maximum capacity. The minimum signal to interference ratio required is 15dB.	(8) (7)	BTL1	Remembering
2	A spectrum of 30 MHz is allocated to a wireless FDD cellular system which uses two 25 KHz simplex channels to provides full duplex voice and control channels. Compute the number of channels available per cell if a system uses 4 cell reuse. Also repeat the computation for 12 cell reuse. If 1 Type equation here.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.	(15)	BTL3	Applying
3	(i) Formulate 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 given C= 20 with A= 11.10 and another system with C= 100 with A= 80.9. Assume each user generates 0.1 Erlangs of traffic.	(8) (7)	BTL4	Analysing
4	Assess the important techniques to improve coverage and capacity in Cellular systems with suitable diagrams. Also explain the capacity expansion techniques.	(15)	BTL2	Understanding
5	A hexagonal cell within a four cell system has a radius of 1.387 km. 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?	 (5) (5) (5)	BTL4	Analysing

	UNIT – II WIRELESS CHANNELS		
	Mobile Radio Propagation: Large scale path loss – Free Space Propagation Model, Basic Propagation mechanisms-Reflection, Diffraction, Scattering. Path loss models- Outdoor and Indoor propagation models, Link Budget design, Small scale path loss-Types of small scale fading – Fading effects due to Multipath time delay spread, Fading effects due to Multipath time Doppler spread.		
	PART – A		
Q. No.	**Questions**	**BT Level**	**Competence**
1.	Give the equation for average large scale-path loss between the transmitter and receiver as a function of distance.	BTL1	Remembering
2.	Illustrate the features of multipath propagation.	BTL2	Understanding
3.	Point out the three basic propagation mechanisms.	BTL2	Understanding
4.	What are the factors that contribute to the rapid fluctuations of the signal amplitude?	BTL1	Remembering
5.	What is meant by EIRP?	BTL1	Remembering
6.	Define coherence time.	BTL1	Remembering
7.	What is meant by coherence bandwidth?.	BTL1	Remembering
8.	Relate small scale fading and large scale fading.	BTL4	Analysing
9.	Write the Friis free space equation.	BTL2	Understanding
10.	Compare fast and slow fading.	BTL4	Analysing
11.	What is flat and frequency selective fading?.	BTL2	Understanding
12.	Illustrate the term "Fresnel Zone".	BTL3	Applying
13.	Justify the need for outdoor propagation model?.	BTL3	Applying
14.	Solve 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	BTL3	Applying
15.	Point out the difference between delay spread and Doppler spread..	BTL4	Analysing
16.	Analyse the various parameters used in Link Budget calculation.	BTL4	Analysing
17.	Mention the different types of outdoor propagation model?.	BTL2	Understanding
18.	Interpret the term Doppler Shift with respect to wireless communication.	BTL3	Applying
19.	Compare Small scale fading based on multi path time delay and Doppler spread.	BTL4	Analysing
20.	Devise how flat fading is experienced in wireless communication	BTL3	Applying
21.	List the factors to be considered for link budget design.	BTL1	Remembering
22.	Give examples for indoor propagation model.	BTL2	Understanding
23.	How to determine the partition losses between floors in indoor propagation model?.	BTL3	Applying

24.	Mention the four categories of non-LoS path in Durkin's model.	BTL2	Understanding	
	PART – B			
Q. No.	**Questions**		**BT Level**	**Competence**
1.	Explain the free space propagation model in detail with no obstacle in between the TX and RX.	(13)	BTL 1	Remembering
2.	Describe small scale fading and parameters of mobile multipath channels.	(13)	BTL 1	Remembering
3.	Assume if a transmitter produces 50 W of power, express the transmit power in units of dBm and dBW. 50W is applied to a unity gain antenna with a 900 MHz carrier frequency. Solve for the received power in dBm at a free space distance of 100m from the antenna also justify the analytical expression by computing the received power at 10 km	(13)	BTL 3	Applying
4.	If a transmitter produces 50 watts of power, express the transmit power in units of (a) dBm, and (b) dBW. If 50 watts 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 100 m from the antenna, What is P (10 km) 2 Assume unity gain for the receiver	(13)	BTL 4	Analyzing
5.	If the transmitter power is 1W and carrier frequency is 2.4 GHz and the receiver is at a distance of 1 mile(1.6 km) from the transmitter. Assume that the transmitter and receiver antenna gains are 1.6. Determine the received power in dBm in the free space of a signal, the path loss in dB and the transmission delay?.	(13)	BTL 4	Analyzing
6.	What are the functions of outdoor propagation models? Explain how okumura model can be used for prediction of signal strength in urban areas.	(13)	BTL 3	Applying
7.	(i) Explain Doppler shift when a mobile move with constant velocity. (ii) List the factors influencing small scale fading and explain the factors.	(7) (6)	BTL 1	Remembering
8.	(i) Analyze Doppler spread and coherence time that describe the time varying nature of the channel in a small scale region. (ii) Calculate the Doppler spread if the carrier frequency is 1900 MHz and velocity is 50 m/s.	(7) (6)	BTL 4	Analyzing
9.	Analyze the process to achieve a balanced link budget and obtain the received power and EIRP.	(13)	BTL 4	Analyzing
10.	Describe the of the two-ray ground reflection model and obtain the path loss.	(13)	BTL 2	Understanding
11.	Assess the parameters of mobile multipath channels with their significance.	(13)	BTL 4	Analyzing
12.	Classify the small scale fading in wireless channel based on multipath time delay spread and explain its features.	(13)	BTL 2	Understanding
13.	Illustrate the terrain profile of outdoor propagation using Durkin's model.	(13)	BTL 2	Understanding
14.	Explain the major classification on fading behavior of the received signal in mobile radio channel.	(13)	BTL 1	Remembering

15.	(i) Discuss in detail about fast fading and slow fading in wireless channel. (ii) Summarize the effects of fading with respect to symbol period and baseband signal bandwidth	(7) (6)	BTL 2	Understanding
16.	Summarize the impact of basic propagation mechanisms in mobile communication system with necessary diagrams and equations.	(13)	BTL2	Understanding
17.	Describe the role of indoor propagation models in mobile radio propagation using two models.	(13)	BTL3	Applying
	PART C			
1.	In digital cellular system if fc=900MHz and the mobile velocity is 70km/hr, evaluate the received carrier frequency if the mobile (i) Directly towards the transmitter (positive Doppler shift) (ii) Directly away from the transmitter (negative Doppler shift) (iii) In the direction perpendicular to the direction of the arrival of the transmitted signal.	(5) (5) (5)	BTL 1	Remembering
2.	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 B_D for the channel?	(15)	BTL 4	Analyzing
3.	Consider free space propagation, a receiver is located 10km away from a 50W transmitter. The carrier frequency is 900MHz, antenna gain at transmitter and receiver is 1 and 2 respectively, calculate power at receiver, magnitude of E field at the RX, the power flux density and the RMS voltage applied to the RX input if antenna as 50 Ω impedance.	(15)	BTL 2	Understanding
4.	Estimate 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 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.	(15)	BTL 4	Analyzing
5	Find the median path loss using Okumura's model for d = 50 km, hte = 100 m, hre = 10 m in a suburban environment. If the base station transmitter radiates an EIRP of I kW at a carrier frequency of 900 MHz, find the EIRP (dBm) and power at the receiver where gain at receiving antenna is 10dB.	(15)	BTL 3	Applying

UNIT – III DIGITAL SIGNALING FOR FADING CHANNELS

Structure of a wireless communication link, Principles of Minimum Shift Keying, Gaussian Minimum Shift Keying, OFDM principle – Cyclic prefix, Windowing, PAPR.

Q. No.	Questions	BT Level	Competence
1.	Name the steps involved in transmission in the wireless communication link.	BTL 1	Remembering

2.	What do you mean by cyclic prefix?	BTL 1	Remembering
3.	Define the concept of windowing.	BTL 1	Remembering
4.	How would you explain non coherent detection?	BTL 1	Remembering
5.	Name some PAPR reduction techniques.	BTL 1	Remembering
6.	Mention the approaches used to improve the OFDM performance.	BTL 1	Remembering
7.	Show the structure of generic optimum receiver.	BTL 2	Understanding
8.	Compare the difference between FDMA and OFDM.	BTL 2	Understanding
9.	Give the function of Gaussian filter in GMSK.	BTL 2	Understanding
10.	Differentiate between MSK and GMSK.	BTL 2	Understanding
11.	Outline about the clipping and windowing.	BTL 2	Understanding
12.	Interpret the term PAPR with necessary equations.	BTL 2	Understanding
13.	Review the features of OFDM.	BTL 3	Applying
14.	Examine the mathematical expression for orthogonality property.	BTL 3	Applying
15.	Solve the expression for bit error rate in GMSK.	BTL 3	Applying
16.	Assess the importance of a Gaussian filter in GMSK	BTL 3	Applying
17.	Why is MSK referred to as fast FSK?	BTL 3	Applying
18.	Sketch the mathematical link model for the analysis of modulation formats.	BTL 3	Applying
19.	Point out the term Bandwidth efficiency.	BTL 4	Analyzing
20.	Analyze the peak to average power ratio problems.	BTL 4	Analyzing
21.	Infer the benefits of cyclic prefix.	BTL 4	Analyzing
22.	In what way digital communication are advantageous over analog communication.	BTL 4	Analyzing
23.	Analyse and list any two criteria for choosing a modulation technique for a specific wireless communication.	BTL 4	Analyzing
24.	Explain the concept of orthogonality.	BTL 4	Analyzing

PART – B

Q. No.	Questions		BT Level	Competence
1.	What is MSK? Explain its power spectral density with neat diagram.	(13)	BTL 1	Remembering
2.	(i) Find the 3-dB bandwidth for a Gaussian low pass filter used to produce 0.25 GMSK with a channel data rate of R_b = 270 Kbps. What is the 90% power bandwidth in the 1W channel? Specify the Gaussian filter parameter α. (ii) Describe the digital modulation in frequency selective mobile channels.	(5) (8)	BTL 1	Remembering
3.	Describe the modulation of GMSK and its advantages with neat block diagram.	(13)	BTL 1	Remembering
4.	What is OFDM? Derive the expression for implementation of transceivers in OFDM.	(13)	BTL 1	Remembering

5.	Write a detailed note on windowing techniques in OFDM system.	(13)	BTL 1	Remembering
6.	Explain in detail about Gaussian Minimum Shift Keying transmission and reception with necessary block diagram.	(13)	BTL 2	Understanding
7.	Summarize the expression for cyclic prefix in frequency selective channels.	(13)	BTL 2	Understanding
8.	Draw the structure of a wireless communication link and summarize the functions of components in detail.	(13)	BTL 2	Understanding
9.	(i) Discuss in detail about the PAPR in OFDM system. (ii) Explain about the impulse response of a Gaussian pulse shaping filter.	(8) (5)	BTL 2	Understanding
10.	How would you describe the generation and demodulation of Minimum Shift Keying signals? Explain in detail?	(13)	BTL 3	Applying
11.	Derive the expression for peak to average ratio reduction techniques.	(13)	BTL 3	Applying
12.	(i) Find the 3-dB bandwidth for a gausian low pass filter used to produce o.25 GMSK with a channel data rate of Rb = 270 kbps. What is the 90% power bandwidth in the RF channel? (ii) Mention the significance of GMSK in wireless communication.	(8) (5)	BTL 3	Applying
13.	Assess the principle of OFDM systems and explain its operation with neat block diagram.	(13)	BTL 3	Applying
14.	(i) Analyze the performance of cyclic prefix in frequency selective channels. (ii) List the functions of PAPR in OFDM systems.	(8) (5)	BTL 4	Analyzing
15.	(i) Examine the function of cyclic prefix and explain the performance of frequency selective channels? (ii) Compare the modulation techniques MSK and GMSK.	(8) (5)	BTL 4	Analyzing
16.	Evaluate the expression for Bit error rate performance of binary modulation schemes in a Rayleigh, flat fading channel.	(13)	BTL 4	Analyzing
17.	Deduce the expression for Bit error rate and power spectral density of GMSK.	(13)	BTL 4	Analyzing
PART – C				
1.	Explain about OFDM system converts the delay spread channel into a set of parallel fading channels using the concept of cyclic prefix.	(15)	BTL 1	Remembering
2.	Analyze the performance of Digital Modulation in Slow, Flat Fading Channels.	(15)	BTL 4	Analyzing
3.	Summarize the effects of High Peak-to-Average Power Ratio (PAPR) of the transmitted signal and assess the PAPR reduction methods	(15)	BTL 2	Understanding
4.	Illustrate the fading channel models and its performance in wireless communication.	(15)	BTL 3	Applying
5.	Assess why constant envelope modulation schemes such as MSK and GMSK are used in a wireless communication system? Compare and contrast these two modulation techniques.	(15)	BTL 4	Analyzing
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.				

	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 and Macro diversity.	BTL 1	Remembering
4.	Outline the concepts of STCM.	BTL 1	Remembering
5.	List the techniques used to improve the received signal quality.	BTL 1	Remembering
6.	Relate the factors used in adaptive algorithms.	BTL 1	Remembering
7.	Compare between diversity gain versus array gain.	BTL 2	Understanding
8.	Outline the advantages of LMS algorithm.	BTL 2	Understanding
9.	Identify the different methods used for temporal diversity.	BTL 2	Understanding
10.	How least mean square algorithm is used in equalization techniques?	BTL 2	Understanding
11.	State the significance of linear and decision feedback equalizer.	BTL 2	Understanding
12.	Obtain the principles of maximum ratio combining and equal gain combining.	BTL 2	Understanding
13.	Assume four branches are used, where each branch receives an independent Rayleigh fading signal. If the average SNR is 20dB, determine the probability that the SNR will drop below 10dB. Compare this with the case of a single receiver without diversity.	BTL 3	Applying
14.	Classify the diversity and its combining techniques.	BTL 3	Applying
15.	In digital cellular equalizer, if the carrier frequency is 900 MHz and maximum Doppler shift is 66.67 Hz, calculate the maximum mobile velocity for the given Doppler shift.	BTL 3	Applying
16.	Solve the correlation coefficient of diversity.	BTL 3	Applying
17.	Shoe the differences among selection and combining diversity.	BTL 3	Applying
18.	Examine the MMSE decision feedback equalizer.	BTL 3	Applying
19.	Compare and contrast linear equalizers and nonlinear equalizers.	BTL 4	Analyzing
20.	Classify the implementation methods in macro diversity.	BTL 4	Analyzing
21.	Analyse the folded frequency response of channel in zero force algorithm.	BTL 4	Analyzing
22.	Design the structure of maximum likelihood sequence estimator (MLSE) in nonlinear equalizer.	BTL 4	Analyzing
23.	Why non-linear equalizers are preferred? List out the non-linear equalization methods.	BTL 4	Analyzing
24.	Point out the applications of nonlinear equalizers.	BTL 4	Analyzing

PART – B

Q. No.	Questions		BT Level	Competence
1.	Summarize about the working principle of linear and non-linear equalizers with neat diagram.	(13)	BTL 1	Remembering
2.	(i) List and explain the various factors that affect the performance of adaptive equalization. (ii) Write the different types of adaptive equalization methods.	(8) (5)	BTL 1	Remembering

3.	Sketch the decision feedback equalizer block diagram and explain its working principle and derive an expression for its minimum mean square error.	(13)	BTL 1	Remembering
4.	Describe the two modes of operating methods in adaptive equalizer and compare the performance of various algorithms for adaptive equalization.	(13)	BTL 1	Remembering
5.	Explain about DFE and MLSE equalizers with neat diagram.	(13)	BTL 1	Remembering
6.	(i) Describe about RLS algorithms with necessary equations. (ii) Express the LMS algorithm for an adaptive equalizer.	(7) (6)	BTL 2	Understanding
7.	Give a short note on the following, (i) Spatial Diversity. (ii) Polarization Diversity.	 (7) (6)	BTL 2	Understanding
8.	Discuss the principle of diversity and various diversity schemes with their advantages and disadvantages.	(13)	BTL 2	Understanding
9.	(i) Write a brief note on categories of space diversity reception methods. (ii) What are zero forcing equalizer algorithms? Explain.	(7) (6)	BTL 2	Understanding
10.	Illustrate the different types of diversity combining methods used in multipath propagation model.	(13)	BTL 3	Applying
11.	Demonstrate macro diversity. Obtain the RSSI and BER in selection diversity.	(13)	BTL 3	Applying
12.	Classify the two main algorithms used under linear equalizers and explain them in detail.	(13)	BTL 3	Applying
13.	Assess the different types of diversity techniques used in wireless communication with necessary analytical models.	(13)	BTL 4	Analyzing
14.	Examine the different types of diversity techniques and explain Time, Frequency and Angular diversity techniques.	(13)	BTL 4	Analyzing
15.	Describe the error performance in fading channel and obtain the canonical receiver structure.	(13)	BTL 4	Analyzing
16.	With relevant diagrams explain Rake receiver. Also explain how time diversity is achieved in CDMA using Rake receiver.	(13)	BTL 3	Applying
17.	Describe the role played by equalization and diversity as multipath mitigation techniques. Compare and contrast these two techniques.	(13)	BTL 4	Analyzing
PART – C				
1.	Summarize about the importance of equalization and diversity methods used for the mitigation of interference in multipath propagation model. Compare and contrast these two techniques.	(15)	BTL 1	Remembering
2.	Explain in detail the various factors to determine the algorithm for adaptive equalizer. Also derive the least mean square algorithm for adaptive equalizer.	(15)	BTL 2	Understanding
3.	(i) Explain 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 4	Analyzing
4.	Find out a suitable technique applied in mobile communication receiver circuit in a multipath environment to eliminate fading copies of one signal. Explain in detail.	(15)	BTL 3	Applying
5.	Analyze the performance of adaptive equalizers with necessary equations and also prove that it exhibits superior performance over the conventional equalizers.	(15)	BTL 4	Analyzing

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. Software defined antenna.

PART - A

Q. No.	Questions	BT Level	Competence
1.	What are smart antenna systems?	BTL 1	Remembering
2.	Define MIMO Systems.	BTL 1	Remembering
3.	List the different types of diversity schemes.	BTL 1	Remembering
4.	How would you explain the capacity of a fading channel?	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 transmit beamforming and receive beam forming.	BTL 2	Understanding
8.	Summarize about the capacity in non-fading channels.	BTL 2	Understanding
9.	Interpret the ergodic capacity and give its expression.	BTL 2	Understanding
10.	Discuss the transmit precoding.	BTL 2	Understanding
11.	Demonstrate receiver diversity	BTL 3	Applying
12.	Discover any two diversity techniques in MIMO system.	BTL 3	Applying
13.	Illustrate the channel state information. What is the benefit of it?	BTL 3	Applying
14.	Specify about antenna diversity.	BTL 4	Analyzing
15.	Classify Beamforming and explain Opportunistic Beamforming.	BTL 4	Analyzing
16.	Differentiate CSI, CSIT, and CSIR.	BTL 4	Analyzing
17.	Discriminate transmit and receive diversity.	BTL 4	Analyzing
18.	Assess the methods to increase the capacity of wireless system, without increasing required spectrum.	BTL 3	Applying
19.	Develop multi user MIMO systems.	BTL 2	Understanding
20.	Create the structure of a MIMO system model.	BTL 3	Applying
21.	What is Software defined Antenna?	BTL 4	Analyzing
22.	Mention the applications of SDR.	BTL 2	Understanding
23.	What is Fading?	BTL 4	Analyzing
24.	Show the difference between beamforming and MIMO?	BTL 3	Applying

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.	Explain the operation of spatial multiplexing with relevant diagrams.	(13)	BTL 1	Remembering

3.	Define precoding and explain the operation of transmit precoding.	(13)	BTL 1	Remembering
4.	Describe about Multiple antenna techniques.	(13)	BTL 2	Understanding
5.	Quote on diversity and explain STC and bandwidth efficiency.	(13)	BTL 1	Remembering
6.	Discuss on Channel State Information at Tx and Rx.	(13)	BTL 2	Understanding
7.	Describe the capacity of a fading and non-fading channel for information transmitted from a wireless system.	(13)	BTL 2	Understanding
8.	Why beamforming is important for wireless systems? Write short notes on transmit diversity.	(13)	BTL 3	Applying
9.	Illustrate on selection diversity and equal ratio combining.	(13)	BTL 3	Applying
10.	Demonstrate the coding and decoding schemes in channels and plot the average SNR Vs C/B.	(13)	BTL 3	Applying
11.	Compare the capacity of fading and non-fading channel for information transmitted from wireless system.	(13)	BTL 4	Analyzing
12.	Analyze on the receiver diversity and combination of signals.	(13)	BTL 4	Analyzing
13.	Explain in detail maximal ratio combiner technique and its advantages.	(13)	BTL 4	Analyzing
14.	Evaluate the system model and precoding for multi-user MIMO systems.	(13)	BTL 3	Applying
15.	Describe in detail on the classification of the BS antenna configuration.	(13)	BTL 4	Analyzing
16.	Explain the concept of water filling/pouring.	(13)	BTL 1	Remembering
17.	Describe the function of Software defined antenna and also discuss about its applications.	(13)	BTL 2	Understanding

PART - C

1.	Analyze the fading and non-fading channel with respect to capacity and discuss each in detail.	(15)	BTL 4	Analyzing
2.	Derive the expression for performance improvement due to Maximal Ratio Combining.	(15)	BTL 2	Understanding
3.	Determine the capacity of slow fading channel and obtain the outage probability for receive diversity system with L receive antennas.	(15)	BTL 1	Remembering
4.	(i) Elaborate the different types of diversity technique. Explain each in detail. (ii) Explain the concept of multiplexing in spatial domain.	(8) (7)	BTL 3	Applying
5.	Discuss about the basic requirements of Software defined antenna and explain about the interference reduction techniques used id SDR.	(15)	BTL 4	Analyzing