SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

VI SEMESTER

EC3661 – WIRELESS COMMUNICATION

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UNIT I - THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS

Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations. Interference and System Capacity: Co-Channel Interference and System Capacity-Channel Planning For Wireless Systems, Adjacent Channel Interference, Improving Coverage and Capacity In Cellular Systems: Cell Splitting, Sectoring.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	Define a cellular system and its primary objective.	CO1	BTL1	Remembering
2.	State the concept of frequency reuse.	CO1	BTL1	Remembering
3.	What is channel assignment strategy?	CO1	BTL1	Remembering
4.	Differentiate fixed and dynamic channel assignment.	CO1	BTL2	Understanding
5.	Define frequency re-use ratio.	CO1	BTL1	Remembering
6.	Define handoff and state its importance.	CO1	BTL1	Remembering
7.	Give the expression for system capacity using frequency reuse.	CO1	BTL1	Remembering
8.	Mention the significance of hexagon shape in cell structure?	CO1	BTL2	Understanding
9.	Summarize the different modules of a basic cellular system.	CO1	BTL2	Understanding
10.	Mention the importance of frequency reuse in cellular networks.	CO1	BTL2	Understanding
11.	Summarize the need for frequency reuse in mobile networks.	CO1	BTL2	Understanding
12.	Differentiate briefly between handoff and roaming.	CO1	BTL1	Remembering
13.	How does the handoff threshold minimize the call dropping probability?	CO1	BTL1	Remembering
14.	Classify the channel assignment strategies and mention its requirements.	CO1	BTL2	Understanding
15.	Compare co channel interference and adjacent channel interference.	CO1	BTL2	Understanding
16.	Paraphrase fixed channel and dynamic channel assignment strategies.	CO1	BTL2	Understanding
17.	Infer the importance of cell splitting and sectoring in networks.	CO1	BTL2	Understanding
18.	Illustrate 60° and 120° cell sectoring in cellular networks.	CO1	BTL2	Understanding
19.	What is cluster? What is its significance?	CO1	BTL1	Remembering
20.	What are the factors influencing small scale fading?	CO1	BTL1	Remembering
21.	What are the different methods available to increase the capacity of the system?	CO1	BTL2	Understanding
22.	Give an expression for capacity of a system.	CO1	BTL2	Understanding
23.	Interpret few techniques used to improve the coverage and capacity of cellular systems.	CO1	BTL2	Understanding
24.	How does the microcell zone concept improve the system capacity?	CO1	BTL2	Understanding

PART-B

1.	Explain in detail the different types of services in wireless communication?	16	CO1	BTL3	Applying
2.	Explain in detail about the following (i) Cellular network architecture. (ii) How frequency is efficiently allocated in a cellular	8 8	CO1	BTL3	Applying

	radio system.				
3.	Discuss different techniques used for improving coverage and capacity in cellular systems	16	CO1	BTL3	Applying
4.	How would you explain the importance of capacity calculation in cellular system and narrate the methods to achieve it?	16	CO1	BTL4	Analyzing
5.	(i) Write about frequency reuse concept. Derive the frequency reuse factor of a cellular system.	16	CO1	BTL3	Applying
6.	(i) Explain in detail about channel assignment strategies. Tabulate the difference between fixed channel and dynamic channel assignment techniques.	16	CO1	BTL3	Applying
7.	Explain about noise and interference limited system	16	CO1	BTL3	Applying
8.	Obtain the expression of signal to interference ratio for the worst case of first tier of co-channel.	16	CO1	BTL3	Applying
9.	(i) Illustrate the techniques to improve coverage and channel capacity in cellular systems? (ii) Explain the capacity improvement techniques in detail.	8 8	CO1	BTL3	Applying
10.	Explain the interference concepts with suitable diagrams and mention the drawbacks of interference.	16	CO1	BTL3	Applying
11.	What would result if handoff strategies involved in cellular systems? Explain in detail.	16	CO1	BTL3	Applying
12.	(i) Compare co-channel interference with adjacent channel interference. (ii) Describe the techniques to avoid co-channel Interference.	8 8	CO1	BTL4	Analyzing
13.	Explain the concepts of (i) Repeaters used for range extension and (ii)Microcell zone concept.	 8 8	CO1	BTL4	Analyzing
14.	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?	 5 5 6	CO1	BTL4	Analyzing
15.	A spectrum of 30MHz is allocated to a wireless FDD cellular system which uses two 25kHz 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 1MHz 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.	16	CO1	BTL4	Analyzing
16.	How is handoff in a cellular system implemented? Explain the different types of handoffs.	16	CO1	BTL4	Analyzing
17.	Illustrate the concept of frequency reuse by designing a	16	CO1	BTL3	Applying

	reuse pattern for a hexagonal cellular system of given area.				

UNIT II - MOBILE RADIO PROPAGATION

Large Scale Path Loss: Introduction To Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction – Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread And Coherence Time. Types Of Small Scale Fading: Fading Effects Due To Multipath Time Delay Spread, Fading Effects Due To Doppler Spread.

PART – A

Q.No	Questions	COs	BT Level	Competence
1.	Give the equation for average large scale-path loss between the transmitter and receiver as a function of distance.	CO2	BTL1	Remembering
2.	Illustrate the features of multipath propagation.	CO2	BTL2	Understanding
3.	Point out the three basic propagation mechanisms.	CO2	BTL2	Understanding
4.	What are the factors that contribute to the rapid fluctuations of the signal amplitude?	CO2	BTL1	Remembering
5.	Define Doppler shift and Doppler spread.	CO2	BTL1	Remembering
6.	Define coherence time.	CO2	BTL1	Remembering
7.	What is meant by coherence bandwidth?	CO2	BTL1	Remembering
8.	Point out the differences between small scale fading and large scale fading.	CO2	BTL2	Understanding
9.	Write the Friis free space equation.	CO2	BTL2	Understanding
10.	Compare fast and slow fading.	CO2	BTL2	Understanding
11.	What is flat and frequency selective fading?	CO2	BTL2	Understanding
12.	Define the term “Fresnel Zone”.	CO2	BTL1	Remembering
13.	What is flat fading? Write its conditions.	CO2	BTL1	Remembering
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 calculate the same for typical ground with permittivity of ϵ_r=15.	CO2	BTL2	Understanding
15.	Compare the difference between delay spread and Doppler spread.	CO2	BTL2	Understanding
16.	What is meant by time dispersion and frequency dispersion?	CO2	BTL2	Understanding
17.	What are the three most important effects due to multipath in mobile radio channel?	CO2	BTL2	Understanding

18.	Express the term Doppler Shift with respect to wireless communication.	CO2	BTL2	Understanding
19.	Compare Small scale fading based on multi path time delay and Doppler spread.	CO2	BTL2	Understanding
20.	Summarize how flat fading is experienced in wireless communication.	CO2	BTL2	Understanding
21.	List the factors affecting path loss.	CO2	BTL1	Remembering
22.	Define knife-edge diffraction and its effect on signal propagation.	CO2	BTL2	Understanding
23.	What is log-distance path loss model?	CO2	BTL2	Understanding
24.	Differentiate small-scale from large-scale fading.	CO2	BTL2	Understanding

	PART-B				
1.	Derive the free space propagation model in detail with no obstacle in between the TX and RX.	16	CO2	BTL 4	Analyzing
2.	Categorize small scale fading and parameters of mobile multipath channels with suitable expressions.	16	CO2	BTL 4	Analyzing
3.	Assume if a transmitter produces 50W 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 10km.	16	CO2	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 antenna.	16	CO2	BTL 4	Analyzing
5.	If the transmitter power is 1W and carrier frequency is 2.4GHz and the receiver is at a distance of 1 mile(1.6km) 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?	16	CO2	BTL 4	Analyzing
6.	In digital cellular system if fc=900MHz and the mobile velocity is 70km/hr, evaluate the received carrier frequency if the mobile is (i) Directed towards the transmitter (positive Doppler shift) (ii) Directed away from the transmitter (negative Doppler shift) (iii) In the direction perpendicular to the direction of the arrival of the transmitted signal.	 5 5 6	CO2	BTL 3	Applying
7.	(i) Illustrate Doppler shift when a mobile move with	8	CO2	BTL 3	Applying

	constant velocity. (ii) List the factors influencing small scale fading and explain the factors.	8			
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.	8 8	CO2	BTL 4	Analyzing
9.	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?	16	CO2	BTL 4	Analyzing
10.	Derive the two-ray ground reflection model and obtain the path loss.	16	CO2	BTL 4	Analyzing
11.	Assess the parameters of mobile multipath channels with their significance.	16	CO2	BTL 4	Analyzing
12.	Classify the small scale fading in wireless channel based on multipath time delay spread and explain its features.	16	CO2	BTL 4	Analyzing
13.	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.	16	CO2	BTL3	Applying
14.	Analyze the major characteristics on fading behavior of the received signal in mobile radio channel.	16	CO2	BTL 4	Analyzing
15.	(i) Examine 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	8 8	CO2	BTL 4	Analyzing
16.	Illustrate the impact of basic propagation mechanisms in mobile communication system with necessary diagrams and equations.	16	CO2	BTL3	Applying
17.	Discuss in detail the large-scale and small-scale radio propagation mechanisms in mobile communication.	16	CO2	BTL3	Applying

UNIT III - EQUALIZATION AND DIVERSITY TECHNIQUES

Equalization, Diversity and Channel Coding: Introduction-Fundamentals Of Equalization- Linear and Non Linear Equalizers, Adaptive Equalization -Diversity Techniques: Micro and Macro Diversity.

PART – A

Q.No	Questions		BT Level	Competence
1.	What is the need of equalization?	CO3	BTL 1	Remembering

2.	Can you brief the principle of diversity?	CO3	BTL 1	Remembering
3.	Define zero forcing equalizer and Macro diversity.	CO3	BTL 1	Remembering
4.	Define diversity in communications.	CO3	BTL 1	Remembering
5.	List the techniques used to improve the received signal quality.	CO3	BTL 1	Remembering
6.	Define adaptive equalization.	CO3	BTL 1	Remembering
7.	Compare diversity gain and array gain.	CO3	BTL 2	Understanding
8.	Outline the advantages of LMS algorithm.	CO3	BTL 2	Understanding
9.	Identify the different methods used for temporal diversity.	CO3	BTL 2	Understanding
10.	How least mean square algorithm is used in equalization techniques?	CO3	BTL 2	Understanding
11.	Give the significance of linear and decision feedback equalizer.	CO3	BTL 2	Understanding
12.	Obtain the principles of maximum ratio combining and equal gain combining.	CO3	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.	CO3	BTL 2	Understanding
14.	Classify the diversity and its combining techniques.	CO3	BTL 2	Understanding
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.	CO3	BTL 2	Understanding
16.	Infer the correlation coefficient of diversity.	CO3	BTL 2	Understanding
17.	Compare the differences among selection and combining diversity.	CO3	BTL 2	Understanding
18.	Recognize the MMSE decision feedback equalizer.	CO3	BTL 1	Remembering
19.	Compare and contrast linear equalizers and nonlinear equalizers.	CO3	BTL 2	Understanding
20.	Outline the implementation methods in macro diversity.	CO3	BTL 2	Understanding
21.	Identify the folded frequency response of channel in zero force algorithm.	CO3	BTL 2	Understanding
22.	Draw the structure of maximum likelihood sequence estimator (MLSE) in nonlinear equalizer.	CO3	BTL 2	Understanding
23.	Why non-linear equalizers are preferred? List out the non-linear equalization methods.	CO3	BTL 2	Understanding
24.	Summarize the applications of nonlinear equalizers.	CO3	BTL 2	Understanding

PART – B					
1.	Summarize about the working principle of linear and non-linear equalizers with neat diagram.	16	CO5	BTL 3	Applying
2.	(i) Construct and explain the various factors that affect the performance of adaptive equalization. (ii)Write the different types of adaptive equalization methods.	8 8	CO5	BTL 3	Applying
3.	Sketch the decision feedback equalizer block diagram and	16	CO5	BTL 3	Applying

	explain its working principle and derive an expression for its minimum mean square error.				
4.	Describe the two modes of operating methods in adaptive equalizer and compare the performance of various algorithms for adaptive equalization.	16	CO5	BTL 3	Applying
5.	Compare DFE and MLSE equalizers with neat diagram.	16	CO5	BTL 4	Analyzing
6.	(i) Describe about RLS algorithms with necessary equations. (ii) Express the LMS algorithm for an adaptive equalizer.	8 8	CO5	BTL 3	Applying
7.	Illustrate in detail the following, (i) Spatial Diversity. (ii) Polarization Diversity.	 8 8	CO5	BTL 3	Applying
8.	Examine with suitable expressions the principle of diversity and various diversity schemes with their advantages and disadvantages.	16	CO5	BTL 3	Applying
9.	(i) Write a brief note on categories of space diversity reception methods. (ii) Analyse the zero forcing equalizer algorithm with suitable expressions?	8 8	CO5	BTL 4	Analyzing
10.	Illustrate the different types of diversity combining methods used in multipath propagation model.	16	CO5	BTL 3	Applying
11.	Explain macro diversity. Obtain the RSSI and BER in selection diversity.	16	CO5	BTL 3	Applying
12.	Classify the two main algorithms used under linear equalizers and explain them in detail.	16	CO5	BTL 3	Applying
13.	Develop an adaptive LMS equalizer and discuss convergence behavior for different step sizes.	16	CO5	BTL 4	Analyzing
14.	Examine the different types of diversity techniques and explain Time, Frequency and Angular diversity techniques.	16	CO5	BTL 4	Analyzing
15.	Describe about the importance of equalization and diversity methods used for the mitigation of interference in multipath propagation model. Compare and contrast these two techniques.	16	CO5	BTL 4	Analyzing
16.	Explain in detail the various factors to determine the algorithm for adaptive equalizer. Also derive the least mean square algorithm for adaptive equalizer.	16	CO5	BTL 4	Analyzing
17.	Describe the role played by equalization and diversity as multipath mitigation techniques. Compare and contrast these two techniques.	16	CO5	BTL 4	Analyzing

UNIT IV - MULTIPLE ACCESS TECHNIQUES

Introduction: Introduction To Multiple Access- Frequency Division Multiple Access(FDMA)- Time Division Multiple Access(TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access(CDMA)- Space Division Multiple Access(SDMA)- Orthogonal Multiple Access (OMA).

PART – A

Q.No	Questions		BT Level	Competence
1.	Define multiple access.	CO4	BTL 1	Remembering

2.	Give the role of guard bands in FDMA.	CO4	BTL 2	Understanding
3.	List any two advantages of TDMA over FDMA.	CO4	BTL 1	Remembering
4.	What is CDMA basic concept?	CO4	BTL 1	Remembering
5.	Define spread spectrum multiple access.	CO4	BTL 1	Remembering
6.	Outline the concept of SDMA.	CO4	BTL 2	Understanding
7.	What is Orthogonal Multiple Access (OMA)?	CO4	BTL 1	Remembering
8.	Differentiate FDMA from TDMA.	CO4	BTL 2	Understanding
9.	Draw the frame structure of TDMA.	CO4	BTL 1	Remembering
10.	Show the process of spreading and despreading in CDMA.	CO4	BTL 2	Understanding
11.	What is frequency hopping?	CO4	BTL 1	Remembering
12.	Define direct sequence spread spectrum.	CO4	BTL 1	Remembering
13.	Give the benefits of SDMA.	CO4	BTL 1	Remembering
14.	What is orthogonality in OMA?	CO4	BTL 1	Remembering
15.	List the multiple access techniques.	CO4	BTL 1	Remembering
16.	Explain the role of guard bands in Frequency Division Multiple Access.	CO4	BTL 2	Understanding
17.	Differentiate the types of handoffs in Code Division Multiple Access.	CO4	BTL 2	Understanding
18.	What is CDMA chip rate?	CO4	BTL 1	Remembering
19.	Give a brief note on TDMA slotting mechanism.	CO4	BTL 2	Understanding
20.	Define processing gain in CDMA.	CO4	BTL 1	Remembering
21.	What is the the role of beam forming in SDMA systems?	CO4	BTL 1	Remembering
22.	What is OFDMA?	CO4	BTL 1	Remembering
23.	List the causes of MAI in CDMA systems.	CO4	BTL 2	Understanding
24.	Write a note on the resource allocation principle in OMA with examples.	CO4	BTL 1	Remembering

PART – B					
1.	For a cellular system using FDMA, calculate number of channels and reuse pattern for a given bandwidth.	16	CO3	BTL 3	Applying
2.	Compare spectral efficiency and capacity of FDMA, TDMA and CDMA for the same bandwidth.	16	CO3	BTL 4	Analyzing
3.	Design a TDMA frame structure for a given number of users and bit rate.	16	CO3	BTL 3	Applying
4.	Evaluate guard time and synchronization requirements in TDMA systems.	16	CO3	BTL 4	Analyzing
5.	Using CDMA principles, determine processing gain and capacity for a set of users and spreading factor.	16	CO3	BTL 3	Applying
6.	Assess the effect of multiple access interference on CDMA system performance.	16	CO3	BTL 4	Analyzing

7.	Formulate a frequency-hopping spread spectrum multiple access scheme for given hop set and dwell time.	16	CO3	BTL 3	Applying
8.	Illustrate the differences between DS-CDMA and FH-CDMA focusing on robustness and complexity aspects.	16	CO3	BTL 4	Analyzing
9.	Describe the planning of SDMA beam-forming patterns for sectorized cells employing antenna arrays.	16	CO3	BTL 3	Applying
10.	Explain the capacity improvement achieved by SDMA using antenna arrays at the base station.	16	CO3	BTL 4	Analyzing
11.	Devise an OFDMA sub-carrier allocation scheme for a set of active users.	16	CO3	BTL 3	Applying
12.	Examine orthogonality loss in OFDMA due to frequency offset and phase noise.	16	CO3	BTL 4	Analyzing
13.	Apply resource allocation strategies to maximize throughput in a multiuser system under fairness constraints.	16	CO3	BTL 3	Applying
14.	Evaluate the impact of power control errors on CDMA cell capacity.	16	CO3	BTL 4	Analyzing
15.	Design a hybrid multiple access scheme combining TDMA and CDMA for a given traffic profile.	16	CO3	BTL 3	Applying
16.	Discuss the relevance of various multiple access schemes for 5G cellular networks.	16	CO3	BTL 4	Analyzing
17.	Identify an appropriate multiple access method for a specific application and justify your choice.	16	CO3	BTL 3	Applying

UNIT V - MIMO COMMUNICATIONS

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	What are smart antenna systems?	CO5	BTL 1	Remembering
2.	Define MIMO Systems.	CO5	BTL 1	Remembering
3.	What is MIMO channel parallel decomposition?	CO5	BTL 1	Remembering
4.	State MIMO channel capacity formula.	CO5	BTL 1	Remembering
5.	Identify the requirements of beam forming.	CO5	BTL 1	Remembering
6.	Outline the working of spatial multiplexing.	CO5	BTL 1	Remembering
7.	Distinguish between transmit beamforming and receive beam	CO5	BTL 2	Understanding
8.	Define space-time block coding (STBC).	CO5	BTL 2	Understanding
9.	Differentiate STTC from Space–Time Block Coding (STBC).	CO5	BTL 2	Understanding
10.	What is transmit precoding?	CO5	BTL 2	Understanding
11.	Differentiate D-BLAST from V-BLAST architectures.	CO5	BTL 2	Understanding
12.	Mention any two diversity techniques in MIMO system.	CO5	BTL 2	Understanding

13.	Illustrate the channel state information. What is the benefit of	CO5	BTL 1	Remembering
14.	Define antenna diversity in wireless communication systems.	CO5	BTL 2	Understanding
15.	Classify Beamforming and explain Opportunistic Beamforming.	CO5	BTL 2	Understanding
16.	Differentiate CSI, CSIT, and CSIR.	CO5	BTL 2	Understanding
17.	Discriminate transmit and receive diversity.	CO5	BTL 2	Understanding
18.	Define BLAST architecture used in MIMO systems.	CO5	BTL 2	Understanding
19.	Differentiate between Single-User MIMO and Multi-User MIMO systems.	CO5	BTL 2	Understanding
20.	Outline the structure of a MIMO system model.	CO5	BTL 2	Understanding
21.	What is Software defined Antenna?	CO5	BTL 2	Understanding
22.	Mention the types of BLAST architectures.	CO5	BTL 2	Understanding
23.	Differentiate open-loop from closed-loop MIMO.	CO5	BTL 2	Understanding
24.	List the advantages of using STTC in fading channels.	CO5	BTL 2	Understanding

PART – B					
1.	What is meant by MIMO systems? Examine the MIMO system model with necessary diagrams in detail.	16	CO6	BTL 3	Applying
2.	Examine the operation of spatial multiplexing with relevant diagrams.	16	CO6	BTL 4	Analyzing
3.	Define precoding and illustrate the operation of transmit precoding.	16	CO6	BTL 3	Applying
4.	Describe about Multiple antenna techniques.	16	CO6	BTL 3	Applying
5.	Determine diversity and explain STC and bandwidth efficiency.	16	CO6	BTL 3	Applying
6.	Illustrate on principles of channel State Information at Transmitter and Receiver.	16	CO6	BTL 3	Applying
7.	Compare performance of STBC and STTC for slow-fading channels.	16	CO6	BTL 4	Analyzing
8.	Why beamforming is important for wireless systems? Write short notes on transmit diversity.	16	CO6	BTL 3	Applying
9.	Assess detection complexity and error propagation in V-BLAST receivers.	16	CO6	BTL 3	Applying
10.	Discuss about the basic requirements of Software defined antenna and explain about the interference reduction techniques used in SDR.	16	CO6	BTL 3	Applying
11.	Determine the capacity of slow fading channel and obtain the outage probability for receive diversity system with L receive antennas.	16	CO6	BTL 4	Analyzing
12.	Analyze on the receiver diversity and combination of signals.	16	CO6	BTL 4	Analyzing
13.	Explain in detail maximal ratio combiner technique and its advantages.	16	CO6	BTL 4	Analyzing
14.	Evaluate the system model and precoding for multi-user MIMO systems.	16	CO6	BTL 3	Applying
15.	Describe in detail on the classification of the BS antenna configuration.	16	CO6	BTL 4	Analyzing

16.	Derive the expression for performance improvement due to Maximal Ratio Combining.	16	CO6	BTL 4	Analyzing
17.	Examine the function of Software defined antenna and also discuss about its applications.	16	CO6	BTL 4	Analyzing