18EC301T- WIRELESS COMMUNICATION

Name	B Priyalakshmi	Unit No.	4
Designation / Department	ASST. PROF./ ECE	Unit Title	Improvement on Link performance

Notations

M - Marks
CO - Course Learning Outcome
BL - Bloom's Level (1. Remembering | 2. Understanding | 3. Applying | 4. Analysing | 5. Evaluating | 6. Creating)
PI - Performance Indicator Code

Note

1. Refer appendix / attachment for Bloom's Taxonomy action verbs
2. Refer appendix / attachment for a model Performance Indicator
3. For each unit / CO, write 20 MCQs (10 questions in Level 1 & 2; 6 or 7 questions in Level 3; 3 or 4 questions in Level 4)
4. Both higher order cognitive skills 'Evaluate' and 'Create' are difficult to assess in time-limited examinations, and hence no questions may not be set up in Levels 5 & 6.
5. Fill up the table of CO / Bloom's Level distribution given at the end of this document.

Q. No.	PART A (MCQ)		M	CO	BL
1.	The capacity of this channel is given by		1	4	2
	A.	$C = B\log(1+P/N_0B)$			
	B.	$C = B\log(1+P/2N_0B)$			
	C.	$C = B\log_2(1+P/N_0B)$			
	D.	$C = B2\log(1+P/2N_0B)$			
	Ans.	C			
2.	The channel SNR, the power in $x[i]$ divided by the power in $n[i]$, is constant and given by		1	4	1
	A.	$\gamma = \frac{P}{N_0B}$			
	B.	$\gamma = \frac{P}{2N_0B}$			

	C.	$\gamma = \frac{PN_o}{2B}$			
	D.	$\gamma = \frac{2P}{N_0 B}$			
	Ans.	A			
3.	______________ characterizes the probability of data loss or of deep fading.		1	4	1
	A.	Capacity with outage			
	B.	Ergodic capacity			
	C.	Outage probability			
	D.	Channel Capacity			
	Ans.	C			
4.	______ is the maximum rate that can be transmitted over a channel with some outage probability corresponding to the probability that the transmission cannot be decoded with negligible error probability.		1	4	1,2
	A.	Shannon capacity			
	B.	Outage Capacity			
	C.	Ergodic capacity			
	D.	Channel capacity			
	Ans.	B			
5.	Shannon capacity of a fading channel with receiver CSI only is ______________ the Shannon capacity of an AWGN channel with the same average SNR.		1	4	1,2
	A.	Greater than			
	B.	Greater than or equal to			
	C.	Equal to			
	D.	Less than			

	Ans.	D			
6.	Mutual information can also be written in terms of the entropy in the channel output y and conditional output $y\|x$ as		1	4	1
	A.	$I(X;Y) = H(X) - H(Y\|X)$			
	B.	$I(X;Y) = H(Y) - H(X\|Y)$			
	C.	$I(X;Y) = H(Y) - H(Y\|X)$			
	D.	$I(X;Y) = H(Y) + H(Y\|X)$			
	Ans.	C			
7.	The Shannon capacity of a fading channel with receiver CSI only is __________ the Shannon capacity of an AWGN channel with the same average SNR.		1	4	1,2
	A.	Equal to			
	B.	Less than			
	C.	Greater than			
	D.	Less than or equal to			
	Ans.	B			
8.	___________ is defined as the point at which the receiver power value falls below the threshold where the power value relates to the minimum signal to noise ratio (SNR) within a cellular communications.		1	4	1,2
	A.	Outage capacity			
	B.	Ergodic capacity			
	C.	Channel capacity			
	D.	Outage Probability			
	Ans.	D			

9.	The capacity-achieving code must be sufficiently long so that a received code word is affected by all possible fading states. This can result in significant delay. By Jensen's inequality		1	4	1,2
	A.	$E[B\log_2(1+\gamma)] = \int B\log_2(1+\gamma)p(\gamma)d\gamma < B\log_2(1+E[\gamma])$			
	B.	$E[B\log\ (1+\gamma)] = \int B\log_2(1+\gamma)p(\gamma)d\gamma \le B\log_2(1+E[\gamma])$			
	C.	$E[B\log_2(1+\gamma)] = \int B\log_2(1+\gamma)p(\gamma)d\gamma \le B\log_2(1+E[\gamma])$			
	D.	$E[B\log_2(1+\gamma)] = \int B\log_2(1+\gamma)p(\gamma)d\gamma \le B\log(1+E[\gamma])$			
	Ans.	C			
10.	Which of these is a necessary condition for optimal power allocation?		1	4	1
	A.	Average transmit power is constant			
	B.	Channel state information known at the transmitter			
	C.	Channel state information known at the receiver			
	D.	Increased transmit power			
	Ans.	B			
11.	For a signal with unity average signal power, the capacity of the channel depends on		1	4	1,2
	A.	Symbol rate			
	B.	modulation			
	C.	receiver sensitivity			
	D.	SNR			
	Ans.	A			
12.	In channel coding theorem, channel capacity decides the ________ permissible rate at which error free transmission is possible.		1	4	1,2
	A.	maximum			
	B.	minimum			
	C.	constant			
	D.	non constant			

	Ans.	A			
13.	Which of the following is true regarding Channel State Information (CSI) for a TDD system?		1	4	1,2
	A.	CSI can be estimated by the transmitter			
	B.	CSI cannot be estimated by the transmitter			
	C.	CSI needs to be fed back from the receiver to the transmitter			
	D.	CSI cannot be estimated by the receiver			
	Ans.	A			
14.	Which of the following is not a category of space diversity technique?		1	4	2
	A.	Selection diversity			
	B.	Time diversity			
	C.	Feedback diversity			
	D.	Equal gain diversity			
	Ans.	B			
15.	In maximal ratio combining, the output SNR is equal to ___________.		1	4	2
	A.	Mean of all individual SNRs			
	B.	Maximum of all SNRs			
	C.	Sum of individual SNR			
	D.	Minimum of all SNRs			
	Ans.	C			
16.	RAKE receiver uses separate __________ to provide the time shifted version of the signal.		1	4	4

	A.	IF receiver			
	B.	Equalizer			
	C.	Correlation receiver			
	D.	Channel			
	Ans.	C			
17.	MIMO stands for ________.		1	4	1,2
	A.	Many input many output			
	B.	Multiple input multiple output			
	C.	Major input minor output			
	D.	Minor input minor output			
	Ans.	B			
18.	In MIMO, which factor has the greatest influence on data rates?		1	4	1,2
	A.	The size of the antenna			
	B.	The height of the antenna			
	C.	The number of transmit antennas			
	D.	The area of receive antennas			
	Ans.	C			
19.	Which of the following technology does not use MIMO?		1	4	1,2
	A.	4G			
	B.	Wi-Fi			
	C.	Wi-MAX			

	D.	AMPS			
	Ans.	D			
20.	Flat fading channel is also known as ________________.		1	4	1,2
	A.	Amplitude varying channel			
	B.	Wideband channel			
	C.	Phase varying channel			
	D.	Frequency varying channel			
	Ans.	A			
21.	For fast fading channel, the coherence time of the channel is smaller than ________ of transmitted signal.		1	4	1,2
	A.	Doppler spread			
	B.	Bandwidth			
	C.	Symbol period			
	D.	Coherence bandwidth			
	Ans.	C			
22.	Equalization is used to compensate ___________.		1	4	1,2
	A.	Peak signal to noise ratio			
	B.	Intersymbol interference			
	C.	Channel fading			
	D.	Noises present in the signal			
	Ans.	B			

23.	The adaptive algorithms in equalizer that do not require training sequence are called ________.		2	4	1,2
	A.	Linear adaptive algorithms			
	B.	Blind algorithms			
	C.	Non-linear adaptive algorithms			
	D.	Spatially adaptive algorithms			
	Ans.	B			
24.	Equalization techniques can be categorised into _______ and ______ techniques.		2	4	1,2
	A.	Linear, non linear			
	B.	Active, passive			
	C.	Direct, indirect			
	D.	Slow, fast			
	Ans.	A			
25.	_______ is a transmission method used in MIMO wireless communications to transmit encoded data signals independently.		2	4	1,2
	A.	Space-time block coding based transmit diversity (STTD)			
	B.	Spatial multiplexing			
	C.	Collaborative uplink MIMO			
	D.	Multiuser MIMO			
	Ans.	B			
26.	A RAKE receiver collects the __________ versions of the original signal.		2	4	1,2
	A.	Time shifted			

	B.	Amplitude shifted			
	C.	Frequency shifted			
	D.	Phase shifted			
	Ans.	A			
27.	The range of time delays that a particular correlator can search is called ________.		2	4	1,2
	A.	Search window			
	B.	Sliding window			
	C.	Time span			
	D.	Dwell time			
	Ans.	A			
28.	Which of the following does not hold true for maximum likelihood sequence estimation (MLSE)?		2	4	1,2
	A.	Minimizes probability of sequence error			
	B.	Require knowledge of channel characteristics			
	C.	Requires the statistical distribution of noise			
	D.	Operates on continuous time signal			
	Ans.	D			
29.	For a discrete memory less time invariant channel with random input x and random output y, the channels mutual information is defined as		2	4	1,2
	A.	$I(X;Y)=\sum_{x\in X, y\in Y} p(x,y)\log\left[\frac{p(x)p(y)}{p(x,y)}\right]$			

	B.	$I(X;Y)=\sum_{x\in X,y\in Y} p(x,y)\log\left[\frac{p(x,y)}{p(x)}\right]$			
	C.	$I(X;Y)=\sum_{x\in X,y\in Y} p(x,y)\log\left[\frac{p(x,y)}{p(y)}\right]$			
	D.	$I(X;Y)=\sum_{x\in X,y\in Y} p(x,y)\log\left[\frac{p(x,y)}{p(x)p(y)}\right]$			
	Ans.	D			
30.	Consider a flat fading channel with i.i.d channel gain, g_1 is 1 with probability is 0.4. The transmit power is 10 mW, the noise power spectral density $N_o/2$ where N_o is 10^{-9} W/Hz and the channel bandwidth is 30 KHz. Assume the receiver has knowledge of the instantaneous value of g_1, Determine the received SNR.		2	4	3,5
	A.	0.413			
	B.	0.334			
	C.	334.33			
	D.	3.334			
	Ans.	C			
31.	_______________applies to slowly-varying channels, where the instantaneous SNR is constant over large number of transmissions and then changes to a new value based on the fading distribution.		2	4	3,4
	A.	Channel capacity			
	B.	Capacity with outage			
	C.	Capacity with Ergodic			
	D.	Shannon capacity			
	Ans.	B			
32.	Consider an AWGN channel with SNR = 18.55 dB. What is the capacity of the channel per unit bandwidth?		2	4	3,5
	A.	7.9 bps/Hz			
	B.	6.18 bps/Hz			

	C.	5.4 bps/Hz			
	D.	73.2 bps/Hz			
	Ans.	B			
33.	Consider the wireless channel with bandwidth of 50 KHz and AWGN with noise power spectral density, $N_o/2$, where N_o is 10^{-9}W/Hz. Find the received SNR for a transmit–receive distance of 1 km.		2	4	3,5
	A.	-15 dB			
	B.	-17 dB			
	C.	-19 dB			
	D.	-20 dB			
	Ans.	B			
34.	If the channel is bandlimited to 6 kHz & signal to noise ratio is 16, what would be the capacity of channel?		2	4	3,4
	A.	15.15 kbps			
	B.	30.12 kbps			
	C.	43.24 kbps			
	D.	24.52 kbps			
	Ans.	D			
35.	Consider the wireless channel with bandwidth of 50 KHz and AWGN with noise power spectral density, $N_o/2$, where N_o is 10^{-9}W/Hz. Determine the channel capacity for transmit–receive distance of 100 m.		2	4	3,4
	A.	219.6kbps			
	B.	200.7 kbps			
	C.	187.3 kbps			
	D.	152.6 kbps			
	Ans.	A			
36.	Consider a flat fading channel with i.i.d channel gain, g_1 is 0.25 with probability is 0.5 and g2 is 1 with probability is 0.4. The transmit power is		2	4	3,4

	10 mW, the noise power spectral density $N_o/2$ where N_o is 10^{-9} W/Hz and the channel bandwidth is 30 KHz. Assume the receiver has knowledge of the instantaneous value of $g_{(i)}$, but the transmitter does not. Calculate the average SNR of this channel.				
	A.	22.42 dB			
	B.	24 .2 dB			
	C.	18.6 dB			
	D.	14.5 dB			
	Ans.	A			
37.	Consider the wireless channel with bandwidth of 50KHz and AWGN with noise power spectral density, $N_o/2$, where N_o is 10^{-9}W/Hz. Determine the channel capacity for a transmit–receive distance of 1 km.		2	4	3,5
	A.	8.5 kbps			
	B.	4.5 kbps			
	C.	2.4 kbps			
	D.	1.42kbps			
	Ans.	D			
38.	Consider a flat fading channel with i.i.d channel gain, g_1 is 2.5×10^{-3} with probability is 0.1. The transmit power is 10 mW, the noise power spectral density $N_o/2$ where N_o is 10^{-9} W/Hz and the channel bandwidth is 60 KHz. Assume the receiver has knowledge of the instantaneous value of g_1, but the transmitter does not. Calculate the Shannon capacity of this channel.		2	4	3,4
	A.	3.014 kbps			
	B.	1.833 kbps			
	C.	301.4 kbps			
	D.	199.26 kbps			

	Ans.	A			
39.	Consider the spectrum of a channel is 100 Hz and SNR of 30 dB. Calculate the maximum channel capacity, in bits per second.		2	4	3,5
	A.	996.72 bps			
	B.	99.672 Mbps			
	C.	0.9977 bps			
	D.	9.96 Mbps			
	Ans.	A			
40.	Consider the wireless channel with bandwidth of 50 KHz and AWGN with noise power spectral density, $N_o/2$, where N_o is 10^{-9} W/Hz. Find the received SNR for a transmit– receive distance of 100 m.		2	4	3,5
	A.	9 dB			
	B.	11 dB			
	C.	13 dB			
	D.	15 dB			
	Ans.	C			

Unit-IV

Capacity, Diversity and Equalization in Wireless systems

PART-B

1. Compare time diversity and frequency diversity.
2. Write about the techniques used to improve the received signal quality in a wireless communication system.
3. What is the necessity of diversity technique in the communication receiver?
4. What are the advantages of maximal ratio combining over selection combining Compare selection combining and feedback combining techniques.

5. How Equal gain combining is different from maximum ratio combining?
6. Give the difference between equalization and diversity.
7. What are the merits and demerits of feedback combining?
8. What is the need for interleaving and why is it used in speech coders?
9. Draw the schematic diagram of a block interleaver and explain its working principle.
10. Derive an expression for Shannon capacity of the channel in an AWGN channel.
11. What is the need for diversity in wireless communication system?
12. Write short notes on interleaving .
13. How bit rate can be improved using equalizer?
14. Give the classification of space or antenna diversity.
15. Contrast Micro diversity and Macro diversity.

PART –C

1. Explain the working principle of RAKE receiver in CDMA systems with a neat block diagram

2. Explain the following combining techniques with neat diagram:
   a. Selection combining
   b. Feedback combining
   c. Maximal ratio combining
3. Derive an expression for capacity of the flat fading channel and its outage when the CSI is known at both transmitter and receiver.
4. Consider a AWGN channel, derive an expression for the capacity of the channel
5. Explain the time diversity and frequency diversity
6. Explain the following diversity techniques:
   i) Time diversity
   ii) Frequency diversity
7. Explain the working principle of block interleaver and any two diversity combining techniques with neat diagram.
8. How does equalizer reduce inter symbol interferences, explain the training and tracking mode of adaptive equalizer.
9. Estimate the Channel capacity with channel state information in wireless system.
10. What do you understand by RAKE receiver? Explain the working of a M branch rake receiver.