**18EC301T- WIRELESS COMMUNICATION**

| Name | Dr. T. Deepa | Unit No. | 4 |
| --- | --- | --- | --- |
| Designation / Department | ASSOCIATE POFESSOR/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.** | **MCQ** | | | **M** | **CO** | **BL** |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | |  |  |  |
| 1. | The capacity of this channel is given by | | | 1 | 4 | 2 |
|  | A. |  | |  |  |  |
|  | B. |  | |  |  |  |
|  | C. |  | |  |  |  |
|  | D. |  | |  |  |  |
|  | 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. |  | |  |  |  |
|  | B. |  | |  |  |  |
|  | C. |  | |  |  |  |
|  | D. |  | |  |  |  |
|  | 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. |  | |  |  |  |
|  | B. |  | |  |  |  |
|  | C. |  | |  |  |  |
|  | D. |  | |  |  |  |
|  | 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. |  | |  |  |  |
|  | B. |  | |  |  |  |
|  | C. |  | |  |  |  |
|  | D. |  | |  |  |  |
|  | 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. |  | |  |  |  |
|  | B. |  | |  |  |  |
|  | C. |  | |  |  |  |
|  | D. |  | |  |  |  |
|  | Ans. | D | |  |  |  |
|  |  |  | |  |  |  |
| 30. | Consider a flat fading channel with i.i.d channel gain, g1 is 1 with probability is 0.4. The transmit power is 10 mW, the noise power spectral density No/2 where No is 10-9 W/Hz and the channel bandwidth is 30 KHz.  Assume the receiver has knowledge of the instantaneous value of g1, 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, No/2, where No is 10-9W/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, No/2, where No is 10-9W/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, g1 is 0.25 with probability is 0.5 and g2 is 1 with probability is 0.4. The transmit power is 10 mW, the noise power spectral density No/2 where No 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. | | | 2 | 4 | 3,4 |
|  | 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, No/2, where No is 10-9W/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, g1 is with probability is 0.1. The transmit power is 10 mW, the noise power spectral density No/2 where No is 10-9 W/Hz and the channel bandwidth is 60 KHz.  Assume the receiver has knowledge of the instantaneous value of g1, 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, No/2, where No 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 | |  |  |  |
|  |  |  | |  |  |  |