**18ECC301T –Wireless Communication**

| Name | C.T.Manimegalai | Unit No. | 3 |
| --- | --- | --- | --- |
| Designation / Department | Associate Professor/ECE | Unit Title | Small Scale Fading |

**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** | **PI** |
| --- | --- | --- | --- | --- | --- | --- |
| 1. | **Small scale multipath propagation is caused due to waves with** | |  | 3 | 1 |  |
|  | A. | Different propagation delays and same phase |  |  |  |  |
|  | B. | Different amplitudes and phase with delays |  |  |  |  |
|  | C. | Different phase and same amplitudes |  |  |  |  |
|  | D. | Same phase |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 2. | **The effects of small scale multipath propagation are** | |  | 3 | 1 |  |
|  | A. | Changes in signal strength,Random frequency modulation,Time dispersion |  |  |  |  |
|  | B. | Random frequency modulation,Time dispersion |  |  |  |  |
|  | C. | Time dispersion |  |  |  |  |
|  | D. | Changes in signal strength |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 3. | **Impulse response of a multipath channel is determined by the fact that** | |  | 3 | 1 |  |
|  | A. | Mobile radio channel may be modeled as non- linear filter |  |  |  |  |
|  | B. | Impulse response is time varying |  |  |  |  |
|  | C. | Linear filter |  |  |  |  |
|  | D. | Impulse response not varying with time |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 4. | **For fast fading channel, the coherence time of the channel is smaller than \_\_\_\_\_\_ of transmitted signal** | |  | 3 | 1 |  |
|  | A. | Bandwidth |  |  |  |  |
|  | B. | Doppler spread |  |  |  |  |
|  | C. | Coherence bandwidth |  |  |  |  |
|  | D. | Symbol period |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 5. | **Flat fading or Frequency non-selective fading is a type of** | |  | 3 | 1 |  |
|  | A. | Multipath delay spread small scale fading |  |  |  |  |
|  | B. | Doppler spread small scale fading |  |  |  |  |
|  | C. | Multipath doppler spread large scale fading |  |  |  |  |
|  | D. | Delay spread large scale fading |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 6. | **In slow fading channels, Doppler spread of the channel is much less than the \_\_\_\_\_of baseband signal**. | |  | 3 | 1 |  |
|  | A. | Phase |  |  |  |  |
|  | B. | Bandwidth |  |  |  |  |
|  | C. | Coherent time |  |  |  |  |
|  | D. | Symbol period |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 7. | **Coherence bandwidth is** | |  | 3 | 1 |  |
|  | A. | channel that passes all spectral components with equal gain |  |  |  |  |
|  | B. | the bandwidth of received signal |  |  |  |  |
|  | C. | channel that passes all spectral components with linear phase |  |  |  |  |
|  | D. | the bandwidth of the transmitted signal |  |  |  |  |
|  | Ans. | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 8. | **Narrowband channels are referred as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |  | 3 | 1 |  |
|  | A. | Phase varying channel |  |  |  |  |
|  | B. | Amplitude varying channel |  |  |  |  |
|  | C. | Frequency varying channel |  |  |  |  |
|  | D. | Wideband channel |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 9. | **Doppler spread refers to\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |  | 3 | 1 |  |
|  | A. | Signal fading due to the doppler shift in the channel |  |  |  |  |
|  | B. | Large coherence time of the channel as compared to the delay constraint |  |  |  |  |
|  | C. | Temporary failure of the message transfer |  |  |  |  |
|  | D. | Small coherence time of the channel as compared to delay constraint |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 10. | **Amplitude varying channel is also known as \_\_\_\_\_\_\_\_\_** | |  | 3 | 1 |  |
|  | A. | Fast fading channel |  |  |  |  |
|  | B. | Flat fading channel |  |  |  |  |
|  | C. | Slow fading channel |  |  |  |  |
|  | D. | Frequency selective channel |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 11. | **The coherence time for fast fading channels is lesser than \_\_\_\_\_\_\_ of transmitted signal.** | |  | 3 | 1 |  |
|  | A. | Doppler spread |  |  |  |  |
|  | B. | Coherence bandwidth |  |  |  |  |
|  | C. | Bandwidth |  |  |  |  |
|  | D. | Symbol period |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 12. | **What is the main disadvantage of RF pulse system?** | |  | 3 | 1 |  |
|  | A. | Complexity |  |  |  |  |
|  | B. | Not real time |  |  |  |  |
|  | C. | Interference and noise |  |  |  |  |
|  | D. | Simplicity |  |  |  |  |
|  | Ans. | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 13. | **The Doppler spread of the slow fading channels is reduced while comparing the \_\_\_\_\_\_\_\_ of baseband signal.** | |  | 3 | 1 |  |
|  | A. | Symbol period |  |  |  |  |
|  | B | Coherence time |  |  |  |  |
|  | C. | Phase |  |  |  |  |
|  | D. | Bandwidth |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 14. | **The envelope of sum of two quadrature Gaussian noise follows \_\_\_\_\_\_\_\_\_ distribution.** | |  | 3 | 1 |  |
|  | A. | Nakagami |  |  |  |  |
|  | B. | Rayleigh |  |  |  |  |
|  | C. | Inverse Gaussian |  |  |  |  |
|  | D. | Gamma |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 15. | **The distribution present in the small scale fading envelope of a non-fading signal component is \_\_\_\_\_\_\_\_\_\_\_\_.** | |  | 3 | 1 |  |
|  | A. | Log normal |  |  |  |  |
|  | B. | Gaussian |  |  |  |  |
|  | C. | Ricean |  |  |  |  |
|  | D. | Rayleigh |  |  |  |  |
|  | Ans. | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 16. | **When the dominant component fades away,the Ricean distribution degenerates to \_\_\_\_\_\_\_\_ distribution.** | |  | 3 | 1 |  |
|  | A. | Gaussian |  |  |  |  |
|  | B. | Rayleigh |  |  |  |  |
|  | C. | Log normal |  |  |  |  |
|  | D. | Gamma |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 17. | **If the symbol period of the transmitted signal is larger than the coherence time of the channel, it is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** | |  | 3 | 1 |  |
|  | A. | Fast fading |  |  |  |  |
|  | B. | Frequency non selective fading |  |  |  |  |
|  | C. | Slow fading |  |  |  |  |
|  | D. | Frequency selective fading |  |  |  |  |
|  | Ans | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 18. | **The envelope of a sinusoid plus bandpass noise has \_\_\_\_\_\_\_\_\_\_distribution.** | |  | 3 | 1 |  |
|  | A. | Ricean |  |  |  |  |
|  | B. | Gaussian |  |  |  |  |
|  | C. | Rayleigh |  |  |  |  |
|  | D. | Uniform |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 19. | **Power delay profile is represented as plots of \_\_\_\_\_\_\_\_\_\_ with respect to fixed time delay reference** | |  | 3 | 2 |  |
|  | A. | Relative received power |  |  |  |  |
|  | B. | Frequency |  |  |  |  |
|  | C. | Transmitted power |  |  |  |  |
|  | D. | Relative power |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 20. | **Which of the following is not a multipath channel parameter that can be determined from power delay profile** | |  | 3 | 3 |  |
|  | A. | Mean excess delay |  |  |  |  |
|  | B. | RMS delay spread |  |  |  |  |
|  | C. | Excess delay spread |  |  |  |  |
|  | D. | Doppler spread |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 21. | **Doppler spread is a range of frequencies over which received Doppler spread is \_\_\_\_\_\_\_** | |  | 3 | 2 |  |
|  | A. | Zero |  |  |  |  |
|  | B. | Non zero |  |  |  |  |
|  | C. | Infinite |  |  |  |  |
|  | D. | Doppler spread |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 22 | **Which is not a part of small scale fading** | |  | 3 | 2 |  |
|  | A. | time selective fading |  |  |  |  |
|  | B. | frequency selective fading |  |  |  |  |
|  | C. | path loss |  |  |  |  |
|  | D. | fast fading |  |  |  |  |
|  | Ans. | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 23 | **For a Rayleigh fading signal, mean and median differ by \_\_\_\_\_\_\_** | |  | 3 | 3 |  |
|  | A. | 2dB |  |  |  |  |
|  | B. | 10dB |  |  |  |  |
|  | C. | 100dB |  |  |  |  |
|  | D. | 0.55dB |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 24 | **Consider an L=4component multipath wireless with components arriving at 0µs, 1µs,3µs,5µs and respective powers of components as -10dB, -20dB, 0dB and -10dB respectively. What is the RMS delay spread of the wireless channel?** | |  | 3 | 3 |  |
|  |  |  |  |  |  |  |
|  | A. | 0.85µs |  |  |  |  |
|  | B. | 1.15µs |  |  |  |  |
|  | C. | 0.95µs |  |  |  |  |
|  | D. | 1.05µs |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 25 | **Coherent time is approximately equal to \_\_\_\_\_** | |  | 3 | 3 |  |
|  | A. | 1/(2xTd), where Td is delay spread |  |  |  |  |
|  | B. | 1/(4xfd), where fd is doppler spread |  |  |  |  |
|  | C. | Allocated bandwidth B |  |  |  |  |
|  | D. | 1/P, where P is the transmitted power |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 26 | **If coherence bandwidth is smaller than the bandwidth of the signal, \_\_\_\_\_ fading occurs.** | |  | 3 | 2 |  |
|  | A. | Flat |  |  |  |  |
|  | B. | Frequency selective |  |  |  |  |
|  | C. | Fast fading |  |  |  |  |
|  | D. | Time selective |  |  |  |  |
|  | Ans | B |  |  |  |  |
|  | . |  |  |  |  |  |
| 27 | **The power delay profile helps in determining** | |  | 3 | 1 |  |
|  | A. | Small scale delay |  |  |  |  |
|  | B. | Rms delay spread |  |  |  |  |
|  | C. | Minimum delay spread |  |  |  |  |
|  | D. | Excess doppler spread |  |  |  |  |
|  | Ans | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 28 | **Fading channels have \_\_\_\_\_\_ and \_\_\_\_\_\_ correlated with each other**. | |  | 3 | 2 |  |
|  | A. | Memory and transmitted samples |  |  |  |  |
|  | B. | Delay and doppler spread |  |  |  |  |
|  | C. | Memory and received samples |  |  |  |  |
|  | D. | Transmitted and received samples |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 29 | **Which of the following is not a characteristic of flat fading?** | |  | 3 | 2 |  |
|  | A. | Mobile radio channel has constant gain |  |  |  |  |
|  | B. | Non-linear phase response |  |  |  |  |
|  | C. | Linear phase response |  |  |  |  |
|  | D. | bandwidth is greater than the transmitted signal bandwidth |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 30 | **The process by which the channel co-efficient changes constantly is termed as \_\_\_\_\_ which gives rise to \_\_\_\_\_\_\_\_.** | |  | 3 | 2 |  |
|  | A. | variation,large bandwidth |  |  |  |  |
|  | B. | modulation ,small coherence bandwidth |  |  |  |  |
|  | C. | fading ,mobility |  |  |  |  |
|  | D. | signal,frequency selectivity |  |  |  |  |
|  | Ans | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 31 | . | **The average fade duration of a Rayleigh fading channel is 37.64 ms.Calculate the maximum Doppler frequency(fm) with threshold level (**ρ**) =1.4** |  | 3 | 2 |  |
|  | A. | 46.16 |  |  |  |  |
|  | B. | 12.65 |  |  |  |  |
|  | C. | 98.45 |  |  |  |  |
|  | D. | 58.11 |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 32 | **The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_give rise to the statistics similar to Rayleigh PDF.** | |  | 3 | 2 |  |
|  | A. | Rician distribution with rice factor(k)=0 |  |  |  |  |
|  | B. | Rician distribution with rice factor(k)= 1 |  |  |  |  |
|  | C. | Nakagami-m distribution with m=1/2 |  |  |  |  |
|  | D. | Nakagami-m distribution with m=1 |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 33 | **Consider an L=5 component multipath wireless with components arriving at 0µs, 2µs,3µs,6µs, 8µs and respective powers of components as -10dB, -20dB, 0dB, -10dB and -20dB respectively. What are the Maximum and RMS delay spread of the wireless channel?** | |  | 3 | 4 |  |
|  | A. | 8µs, 1.299µs |  |  |  |  |
|  | B. | 6µs, 3.032µs |  |  |  |  |
|  | C. | 6µs, 1.299µs |  |  |  |  |
|  | D. | 8µs, 3.032µs |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 34 | **The amount of coherent bandwidth can be approximated by** | |  | 3 | 4 |  |
|  | A. | (BC) in Hertz=1/2π×(Delay Spread) |  |  |  |  |
|  | B. | (BC) in Hertz=2π×(Delay Spread) |  |  |  |  |
|  | C. | Hertz=1/2π×(fast Spread) |  |  |  |  |
|  | D. | (BC) in Hertz=1/(Delay Spread) |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 35 | **A cellular system is operating at a frequency of 1800 MHz. The base station is equipped with a power amplifier (PA) with a gain of GPA = 20 dB. The PA is directly connected to the BS antenna, which has a gain of GTx = 6 dBi. The typical user-equipment is equipped with an omnidirectional antenna with a gain of GRx = 0 dBi, that is directly connected to a low-noise amplifier (LNA) with a gain of GLNA = 10 dB. The system noise figure is assumed to be 0 dB, and the receiver sensitivity is SUE = −120 dBm. The system needs to be able to operate up to distances of 5 km.**    **Assume that the path loss, PL, is modelled as free space path loss plus a lognormal large-scale fading term with # = 6 dB and μ = 0 dB. Based on these parameters for the large-scale fading, a fading margin of 10 dB is chosen with respect to the receiver sensitivity. Calculate the minimum required input power Pin to the PA at the BS in order to fulfil this fading margin. Give the answer in units of Watts.** | |  | 3 | 6 |  |
|  | A. | 0.36µW |  |  |  |  |
|  | B. | -34.5dBW |  |  |  |  |
|  | C. | -35dBW |  |  |  |  |
|  | D. | -0.36µW |  |  |  |  |
|  |  |  |  |  |  |  |
|  | Ans. | D |  |  |  |  |
|  |  |  |  |  |  |  |
| 36 | **Consider a mobile user moving with a velocity of 90kmph at carrier frequency 2.5 GHz and an angle of 45˚. The coherent time of the channel is** | |  | 3 | 4 |  |
|  | A. | 3.38ms |  |  |  |  |
|  | B. | 0.85ms |  |  |  |  |
|  | C. | 1.69ms |  |  |  |  |
|  | D. | 2.1ms |  |  |  |  |
|  | Ans. | C |  |  |  |  |
|  |  |  |  |  |  |  |
| 37 | The power delay profile of a typical urban mobile radio channel is given     1. Estimate the Doppler spread of the corresponding channel. 2. Find the RMS delay spread | |  | 3 | 6 |  |
|  | A. | 1.086µs, 200Hz |  |  |  |  |
|  | B. | 0.086µs, 20Hz |  |  |  |  |
|  | C. | 1.086µs, 20Hz |  |  |  |  |
|  | D. | 0.086µs, 200Hz |  |  |  |  |
|  | Ans. | A |  |  |  |  |
|  |  |  |  |  |  |  |
| 38 | **The Rician K-factor is 3 for a wireless channel.The Nakagami Distribution parameter m is** | |  | 3 | 5 |  |
|  | A. | 1.65 |  |  |  |  |
|  | B. | 7.34 |  |  |  |  |
|  | C. | 2.28 |  |  |  |  |
|  | D. | 5.44 |  |  |  |  |
|  | Ans. | C |  |  |  |  |
| 39 | **The Doppler frequency(fm) of Rayleigh fading channel is is 100Hz.Calculate the approximate level crossing rate for threshold level(ρ)=1.2** | |  | 3 | 4 |  |
|  | A. | 102 crossing/s |  |  |  |  |
|  | B. | 67 crossing/s |  |  |  |  |
|  | C. | 45 crossing/s |  |  |  |  |
|  | D. | 92crossing/s |  |  |  |  |
|  | Ans. | B |  |  |  |  |
|  |  |  |  |  |  |  |
| 40 | **Consider a channel of average received power of 20 dBm with Rayleigh fading.The probability that the received power is below 5dBm is\_\_\_\_\_\_** | |  | 3 | 4 |  |
|  | A. | 0.03113 |  |  |  |  |
|  | B. | 0.02486 |  |  |  |  |
|  | C. | 0.9345 |  |  |  |  |
|  | D. | 0.09345 |  |  |  |  |
|  | Ans. | A |  |  |  |  |

**Course Outcome and Bloom’s Level Distribution to the questions**

| Question No. | Course Outcome Distribution | | | | | | BL Distribution | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CLO-1** | **CLO-2** | **CLO-3** | **CLO-4** | **CLO-5** | **CLO-6** | **L1** | **L2** | **L3** | **L4** | **L5** | **L6** |
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