



M.E DEGREE EXAMINATIONS: JUNE 2017

(Regulation 2015)

Second Semester

COMMUNICATION SYSTEMS

P15COT201: Wireless Communication Engineering

COURSE OUTCOMES

- CO1:** Explain various wireless channel models.
- CO2:** Analyze the performance of digital modulation schemes over wireless channel
- CO3:** Compare different diversity and combining techniques
- CO4:** Explain and analyze multicarrier modulation technique
- CO5:** Compare spread spectrum techniques.
- CO6:** Describe various standards for wireless systems.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. In indoor channel $\sigma_{T_m} = 50ns$. The maximum symbol rate such that a linearly modulated signal transmitted experiences negligible ISI. CO1 [K₂]
 - a) 10 Mbps
 - b) 50 Mbps
 - c) 2 Mbps
 - d) 5 Mbps

2. Match the modulation techniques with the error probability over AWGN channel CO1 [K₂]

List I	List II
A. BPSK	i. $Q(\sqrt{\gamma_b})$
B. BFSK	ii. $\approx Q(\sqrt{2\gamma_b})$
C. QPSK	iii. $Q(\sqrt{2\gamma_b})$

- a) A-iii, B-iii, C-ii
 - b) A-i, B-ii, C-iii
 - c) A-iii, B-ii, C-i
 - d) A-iii, B-i, C-ii
3. Which one of the following diversity technique is both bandwidth and power efficient CO2 [K₂]
 - a) Frequency diversity
 - b) Time diversity
 - c) OFDM
 - d) Antenna Diversity

4. Diversity techniques that mitigate the effect of multipath fading are called CO2 [K₂]
- a) Macrodiversity b) Microdiversity
 c) MRC d) Equal gain
5. The correct sequence of signal processing steps in OFDM transmitter is CO3 [K₂]
- a) IFFT
 b) Add Cyclic prefix
 c) M-QAM modulation
 d) Serial to parallel converter
- a) a-c-d-b b) d-c-b-a
 c) c-a-c-d d) c-d-a-b
6. Peak to average (PAR) of OFDM signal is CO3 [K₂]
- a) 1 b) Number of subcarriers/2
 c) Number of subcarriers d) Square of Number of subcarriers
7. Space Time Coding techniques are CO5 [K₂]
- a) Throughput maximization techniques b) Bandwidth efficient techniques
 c) Diversity maximization techniques d) Power maximization techniques
8. Which of the following technique gives both space diversity and frequency diversity CO5 [K₂]
- a) MIMO b) MIMO-OFDM
 c) Multiuser -MIMO d) OFDMA
9. Assertion (A): Synchronization is relatively easy in the downlink channel CO6 [K₂]
 Reason (R): The down link channel is a multiple access channel
- a) both A and R are individually true and R is the correct explanation of A b) both A and R are individually true but R is not the correct explanation of A
 c) A is false but R is true. d) A is true but R is false
10. The capacity of 4X4 MIMO channel is CO6 [K₂]
- a) 4 times ergodic SISO capacity b) 16 times SISO ergodic capacity
 c) 2 times SISO ergodic capacity d) SISO ergodic capacity

PART B (10 x 2 = 20 Marks)

11. Define Doppler effect CO1 [K₂]
12. Classify the statistical fading channel models based on coherence time and coherence bandwidth. CO1 [K₂]

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| 13. | What is frequency diversity? How independent fading paths are achieved in frequency diversity? | CO2 | [K ₂] |
| 14. | Compare equal gain combining and threshold combining. | CO2 | [K ₂] |
| 15. | How precoding technique is used to mitigate subcarrier fading? | CO4 | [K ₂] |
| 16. | Consider a data signal with a bandwidth of 0.5 MHz and a data rate of 0.5 Mbps. The signal is transmitted over a wireless channel with a delay spread of 10 μs. If multicarrier modulation with non overlapping subchannel is used to mitigate the effects of ISI, approximately how many subcarriers are needed? What is the data rate and symbol time on each subcarrier? ($T_s = T_m$ is sufficient for ISI mitigation) | CO4 | [K ₂] |
| 17. | Draw the flat fading MIMO channel model. | CO5 | [K ₂] |
| 18. | What the advantages of MIMO channel. | CO5 | [K ₂] |
| 19. | Compare uplink and down link channel | CO6 | [K ₂] |
| 20. | How multiuser diversity is achieved in multiuser-MIMO? | CO6 | [K ₂] |

PART C (6 x 5 = 30 Marks)

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| 21. | Derive channel capacity for frequency selective fading channel. | CO1 | [K ₃] |
| 22. | Discuss in detail about maximum ratio combining technique and derive the combined output SNR. | CO3 | [K ₃] |
| 23. | Show that the minimum separation for subcarriers $(\cos(2\pi j\Delta f t + \varphi_j), j = 1, 2, \dots)$ to form a set of orthonormal basis functions on the interval $[0, T_N]$ is $\Delta f = 1/T_N$ for any initial phase φ_j . Show that if $\varphi_j = 0$ for all j then this carrier separation can be reduced by half. | CO4 | [K ₃] |
| 24. | Explain the Alamouti scheme with an example. What are the advantages of Alamouti scheme? | CO3 | [K ₂] |
| 25. | Illustrate the working principle of BLAST architecture with necessary block diagrams. | CO6 | [K ₃] |
| 26. | Compare FDMA, TDMA and SDMA | CO6 | [K ₃] |

Answer any FOUR Questions

PART D (4 x 10 = 40 Marks)

27. Derive the capacity of frequency non selective fading channel for following conditions: (i) CSI known only at the receivers (ii) CSI known at transmitter and receiver CO1 [K₃]
28. Derive the average error probability for BPSK signal over flat fading channel. CO2 [K₃]
29. What are the advantages of Multicarrier modulation? Explain in detail about the discrete implementation of multicarrier system. CO4 [K₃]
30. Derive the MIMO channel capacity for static channel. CO5 [K₃]
31. Discuss in detail about downlink channel capacity. CO6 [K₂]
