

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- May 2018

M.Tech 4th Semester

COURSE CODE: 12M1WEC432

MAX. MARKS: 35

COURSE NAME: Fundamentals of MIMO Systems

COURSE CREDITS: 03

MAX. TIME: 2Hr

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

1. [12 marks] Write a short summary of **maximum 1 page** on the following. CO-1
 - (a) Power allocation in MIMO and water filling.
 - (b) Successive Interference cancellation (SIC)
 - (c) V-BLAST architecture
 - (d) MIMO-OFDM system
 - (e) MIMO Beamforming
 - (f) MIMO in WiMax
2. [4 marks] Comment of applicability of Kronecker MIMO channel model by explaining its correlation matrix. Find Kronecker product of any two arbitrary matrices of size 2x2. CO-1
3. [2 marks] Consider a wireless LAN operating in a factory near a conveyor belt. The transmitter and receiver have a LOS path between them with gain α_0 , phase ϕ_0 and delay τ_0 . Every T_0 seconds a metal item comes down the conveyor belt, creating an additional reflected signal path in addition to the LOS path with gain α_1 , phase ϕ_1 and delay τ_1 . Find the time-varying impulse response $c(\tau, t)$ of this channel. CO-2
4. [2 marks] Consider a channel with Rayleigh fading and average received power $P_r = 20$ dBm. Find the probability that the received power is below 10 dBm. CO-2
5. [3 marks] What are the design criteria for space-time codes? CO-3
6. [6 marks] Derive Diversity gain, coding gain, code rate of Alamouti ST Code. CO-3
7. [2 marks] Find the data rate of an 802.11a system assuming 16QAM modulation and rate 2/3 coding. CO-4
8. [4 marks] This problem illustrates that you can get performance gains from diversity combining even without fading, due to noise averaging. Consider an AWGN channel with N branch diversity combining and $\gamma_i = 10$ dB per branch. Assume MQAM modulation with $M = 4$ and use the approximation $P_b = .2e^{-1.5\gamma/(M-1)}$ for bit error probability, where γ is the received SNR. CO-4
 - (a) Find P_b for $N = 1$. [1]
 - (b) Find N so that under MRC, $P_b < 10^{-6}$. [3]

*****Good Luck*****