Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: WIRELESS COMMUNICATION (ECE - 405)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. Derive an expression for optimal power allocation and Shannon capacity of a block fading channel.

1B. Measurements through a 900 MHz sinusoidal input to a channel resulted in the following channel scattering function; $S(\tau, \rho)$ is $\alpha_1\delta(\tau)$ at $\rho = 70$ Hz and $\alpha_2\ \delta(\tau\text{-}0.022\ \mu s)$ at $\rho = 49.5$ Hz. If the transmitter and receiver are located 800 cm above the ground, (i) Estimate the velocity and distance between the transmitter and receiver. (ii) By what factor the path loss is varying with distance'd' (iii) will a 30 KHz voice signal transmitted over this channel experience frequency selective or flat fading.

(6+4)

2A. Briefly explain all types of receiver diversity techniques.

2B. For a cellular system the reference distance for the antenna far field is 100 m and the path-loss exponent is a random variable taking on values 2, 2.5, 3 and 4 with probabilities 0.4, 0.3, 0.2 and 0.1 respectively. Assume a receiver at a distance of 1000 m from the transmitter with average transmit power constraint of 100 mW and a receiver noise power of 1mW. (i) Assuming that both transmitter and receiver have CSI, find the distribution of the received SNR (ii) Assuming only receiver CSI, determine the ergodic capacity per unit bandwidth for this channel (iii) Assuming both receiver and transmitter CSI, derive the optimal power adaptation policy for this channel and its corresponding Shannon capacity per unit bandwidth (iv) Assuming both receiver and transmitter CSI, determine the zero outage capacity per unit bandwidth of this channel.

(4+6)

3A. For a Rayleigh fading wireless channel, derive an expression for outage probability and average probability of error for BPSK and BFSK modulation

3B. Consider a communication system, with transmitter and Receiver placed 10 m apart, is operating at 1 GHz and has a Time varying channel impulse response with N resolvable multipath components. Show that the minimum value of the product of carrier frequency and nth delay time is very much larger than unity. Is it true if the distance is changed to 1 m and 100 m?

(7+3)

4A. With relevant diagrams, explain the Alamouti scheme of transmitter diversity in the absence of CSI at transmitter.

4B. Show that for a narrowband fading channel the autocorrelation of in-phase and quadrature components of received signal is same and WSS.

(4+6)

5A. Derive an expression for path gain for 2-ray model. Show the power variations with respect to distance between antennas. Also, derive an approximate expression for the distance values below the critical distance at which nulls occur.

5B. Consider an indoor wireless LAN with f_c = 1 GHz, cells of radius 100 m, and omnidirectional antennas. For free space path loss model, what should be the transmitted power if all receivers within the cell are to receive a minimum power of -40 dBm? Repeat your calculation for 500 m.

(7+3)

6A. Let h_t, h_r, G_t and G_r values are 40 m, 3 m, 0 dB and 0 dB respectively, for a wireless communication system operating at 1800 MHz. The power received is $1\mu W$ at a reference distance of 1 km. Find the received power in dBm at 2 km and 10 km distances for the path loss models (i) Free Space (ii) $\gamma = 3$ (iii) Extended Hata model for larger cities.

6B. Define Power Delay Profile and Coherence Bandwidth. Support your answer with the help of necessary equations and figures.

(7+3)