Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SECOND SEMESTER M.TECH (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: WIRELESS COMMUNICATION (ECE - 502)

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

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

1A. Let h_t, h_r, G_t and G_r values are 40m, 3m, 0dB and 0dB 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.

1B. If minimum SNR required for an acceptable performance is 7dB and average SNR is 15dB, find the outage probability of BPSK modulation for 2-branch SSC i.i.d. Rayleigh fading channel with threshold SNR values of 5dB and 10dB.

(6+4)

2A. Show that for a narrowband fading channel the autocorrelation of in-phase and quadrature components of received signal is same and WSS.

2B. Write descriptive note on Diversity. With relevant diagrams, explain the Alamouti scheme of transmitter diversity in the absence of CSI at transmitter.

(6+4)

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

3B. A WSSUS channel has a multipath delay spread of 1 s and Doppler spread of 0.02 Hz. The total channel bandwidth of transmitted signal is 10 Hz and symbol duration chosen is 10 s. (i) Find coherence bandwidth and time (ii) Does channel exhibit frequency selective fading? (iii) Does channel exhibit slow and fast fading? (iv) Find transmission data rate.

(6+4)

4A. 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.

4B. Find the coverage area for a microcellular system where path loss follows the simplified model (with $\gamma = 3$, $d_0 = 1m$, and $K = 0$ dB) and there is also log-normal shadowing with $\sigma = 4dB$. Assume a cell radius of 100m, a transmit power of 80mw, and a minimum received power requirement of P_{min}= -100dBm.

(6+4)

5A. 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 $\alpha_2\, \delta(\tau - 0.022\mu s)$ at $\rho = 49.5$ Hz. If the transmitter and receiver are located 800 cm above the ground, (i) Find the velocity and distance between the transmitter and receiver. (ii) By what factor the path loss is varying with distance (iii) will a 30 KHz voice signal transmitted over this channel experience frequency selective or flat fading.

5B. Explain Power Delay Profile. The multipath intensity profile for a particular channel is given by $A_c(\tau) = \exp(-\tau/0.00001)$ for $0 < \tau < 20\ \mu s$ and zero elsewhere. Find the mean and RMS delay spreads of the channel and find the maximum symbol rate such that a linearly modulated signal transmitted through this channel does not experience ISI.

(5+5)

6A. Explain the importance of MGF. Derive an expression for the average probability of error for DPSK in a Nakagami fading channel with m=1

6B. From the fundamentals, derive an expression for critical distance in two ray model. Find the critical distance for an indoor microcell having $h_t = 3m$ and $h_r = 2m$. Operating frequency is 2GHz.

(5+5)