Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SECOND SEMESTER M. TECH (DEAC) DEGREE END SEMESTER EXAMINATION
APRIL / MAY 2017
SUBJECT: WIRELESS COMMUNICATION (ECE - 5201)

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

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

1A. Derive expressions for autocorrelation, cross correlation and power spectral density of narrow band fading model.

1B. A baseband binary message is modulated by an RF carrier using BPSK and transmitted at the rate of 100 Kbps. (i) Find the range of RMS delay spread of the channel such that signal is flat fading signal (ii) If carrier frequency is 5.8 GHz and receiver is moving with speed of 30 miles/hour, find coherence time. (iii) Whether the channel of part (ii) is fast or slow fading (iv) If channel is static, how many bits are sent for the channel of part (ii)?

(5+5)

2A. A wideband channel has multipath intensity profile given by $\exp\left(-10^5\tau\right)$ in the range $0 \le \tau \le 20\ \mu s$.

(a) Find the coherence bandwidth, if channel's frequency transfer function has correlation exceeds 0.9 (b) Repeat your calculation if correlation is at least 0.5 (c) If symbol rate is 20 kilo symbols per second, whether the signalling will be frequency selective fading and why? (d) What is the value of RMS delay spread?

2B. For a Rayleigh fading wireless channel, derive an expression for outage probability and average probability of error for BFSK modulation.

(5+5)

3A. If the received power at a distance of 1 km is $1\,\mu W$, find the received power in dBm at distances of 2 km, 4 km and 8 km using 2-ray reflection model. Let h_t = 40 m, h_r = 3 m, $G_t = G_r$ = 0 dB, f = 1800 MHz. Also find and compare the received power obtained using simplified model in each of the above cases.

3B. Consider a flat fading channel of bandwidth 20MHz and where, for a fixed transmit power $\bar{P}$, the received SNR is one of three values: γ_1 = 20dB, γ_2 = 10dB, γ_3 = -5dB. The probabilities associated with each state are p_1 = 0.25, p_2 = 0.4 and p_3 = 0.35. Assume that only the receiver has CSI. (a) Find the Shannon capacity of this channel. (b) Plot the capacity versus outage for $0 \le P_{out} \le 1$ and find the maximum average rate that can be correctly received (maximum C_{out}).

(5+5)

4A. Using Hata model for urban and rural area, find the path loss if $f_c = 900\,MHz$, $h_t = 20\,m$, $h_r = 5\,m, d = 100\,m$

4B. Derive an expression for optimal power allocation and Shannon capacity of a block fading channel.

(5+5)

5A. Find the coverage area for a microcellular system where path loss follows the simplified model (with $\gamma = 3$, $d_0 = 1$ m, and K = 0 dB) and there is also log-normal shadowing with $\sigma = 4$ dB. Assume a cell radius of 100 m, a transmit power of 80 mw, and a minimum received power requirement of P_{min}= -100 dBm.

5B. Explain the principle of threshold combining diversity technique and hence derive for average probability of bit error with DPSK modulation employed.

(5+5)