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 - 4101)

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

Instructions to candidates

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

1A. A transmitter radiates 50W of power at 900MHz carrier. The reference distance is 100m. The channel experiences both free space path loss and log-normal shadowing with variance of 5dB. Let the path loss exponent be 3 and K = 0dB. Find the (i) Received power in dBm at 100m (ii) Path loss in dB at 500m (iii) Received power in dBm at 500m (iv) Probability that received power at 500m is $\geq$ 0.01mW

1B. 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 $0 \leq P_{out} \leq 1$ and find the maximum average rate that can be correctly received (maximum C_{out}).

(6+4)

2A. The channel impulse response of an indoor free space channel is $h(\tau,t) = 0.5\cos(2\pi f_1 t)\delta(\tau-20) + 0.3\cos(20\pi f_1 t)\delta(\tau-90) + 0.2\cos(40\pi f_1 t)\delta(\tau-170)$ where τ is in nsec and f_1 = 50Hz. (i) Find the maximum delay spread (ii) Find the maximum Doppler spread (iii) Find the coherence BW and coherence time (iv) Is this channel slow or fast fading, if the transmission is done at 10kbps.

2B. Explain the principle of Threshold combining diversity technique and hence derive for average probability of bit error with DPSK modulation employed.

(5+5)

3A. If X and Y are independent zero mean Gaussian random variables with variance σ^2, show that the random variable $Z = \sqrt{X^2 + Y^2}$ is Rayleigh distributed and Z^2 is exponentially distributed.

3B. For a cellular system operating at 900 MHz, the measured value of the received signal power has log-normal distribution given by $P_r(d) \propto d^{-3.3}$ for a transmitted power of 10 mW. At a reference distance of 1 m, the received power is 1 mW. At a distance of 10 m, it is found to be 11.5% more than the threshold value -28 dBm. Find (a) the standard deviation at 10 m distance. (b) Repeat your calculation, if the distribution is $P_r(d) \propto d^{-3.8}$ with 14.5% more than threshold value of -35 dBm.

(4+6)

4A. 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?

4B. Why an equalizer is required? Explain the principle of working of decision feedback equalizer.

4C. How Doppler spread and ISI affects symbol error probability in fading channels?

(5+3+2)

5A. Derive expressions for Autocorrelation, Cross Correlation and Power Spectral Density of Narrow band fading model.

5B. Find the outage probability of BPSK modulation at $P_b = 10^{-3}$ for a Rayleigh fading channel with SC diversity for the values of M equal to 1, 2 and 3, if branch SNRs value $\overline{\gamma}$ is 15 dB. Repeat your answer for $\overline{\gamma}$ is 19 dB

(5+5)