Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

SEVENTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
NOVEMBER 2018
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 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?

1B. Explain the principle of Threshold combining diversity technique and hence derive for average probability of bit error with DPSK modulation employed.

(5+5)

2A. Define power delay profile and coherence bandwidth. A multipath fading channel has a multipath spread of T_m= 1 second and a Doppler spread B_d= 0.01 Hz. The total channel bandwidth at bandpass available for signal transmission is W= 5Hz. To reduce the effects of ISI, the signal designer selects a pulse duration T=10 s.

(i) Determine the coherence bandwidth and coherence time.

(ii) Is the channel frequency selective? Explain.

(iii) Is the channel fading slowly or rapidly? Explain.

(iv) Find transmission data rate.

2B. 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)

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

3B. 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 σ = 4dB. Assume a cell radius of 100m, a transmit power of 80mw, and a minimum received power requirement of P_{min}= -100dBm. Derive the formula used for calculations.

(3+7)

4A. 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 is 3 and K = 0dB. Find:

(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

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

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

(5+3+2)

5A. Derive an expressions for Cross Correlation functions of a narrowband fading channel.

5B. 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 following path loss models:

(i) Free Space (ii) $\gamma = 3$ (iii) Extended Hata model for larger cities.

(3+7)