Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

SEVENTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
DECEMBER 2018/ JANUARY 2019
SUBJECT: WIRELESS COMMUNICATION (ECE - 4101)

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

Instructions to candidates
- Answer **ALL** 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 ρ = 70 Hz and $\alpha_2\ \delta(\tau\text{-}0.022\ \mu s)$ at ρ = 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. Given a set of empirical path-loss measurements as: (d (m), P_r/P_t (dB)) = (5, -60), (25, -80), (65, -105), (110, -115), (400, -135), (1000, -150). (i) Find the parameter of a simplified path loss model (take d_o = 1 m). (ii) Estimate the path loss at 2 Km based on this model.
Let f = 706 MHz.

2B. Derive an expression for path gain of a 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.

(5+5)

3A. With relevant diagrams, explain the Alamouti scheme of transmitter diversity in the absence of CSI at transmitter.

3B. 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 for the path loss model (i) Free space (ii) Path loss exponent of 3 and 4.

(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. 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.

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 $\bar{\gamma}$ is 15 dB. Repeat your answer for $\bar{\gamma}$ is 19 dB

(5+5)