Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

SEVENTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 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. 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. Derive an expression for path gain for 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.

2B. Consider an indoor wireless LAN with f_c = 1 GHz, cells of radius 100 m, and omnidirectional antennas. For free space path loss model, what should be the transmitted power if all receivers within the cell are to receive a minimum power of -40 dBm? Repeat your calculation for 500 m.

(5+5)

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

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. 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 calculation for $\bar{\gamma}$ of 19 dB.

(5+5)