Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH. (DEC) DEGREE END SEMESTER EXAMINATION

APRIL/MAY 2019

SUBJECT: WIRELESS COMMUNICATION (ECE - 5201)

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

Instructions to candidates

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

1A. For a Rayleigh fading wireless channel, derive an expression for outage probability and average probability of error for BFSK modulation.

1B. Consider a time invariant frequency selective block fading channel that has three sub-channels of bandwidth B=1 MHz. The frequency responses associated with each sub-channel are $H_1 = 1$, $H_2 = 2$, $H_3 = 3$ respectively. The transmit power constraint is P = 10mW and noise PSD $N_o/2$ has $N_o = 10^{-9}$ W/Hz. Find the Shannon capacity of this channel and the optimal power allocation that achieves this capacity.

(5+5)

2A. If the received power at a distance of 1 km is 1 μW, 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.

2B. Derive expressions for Autocorrelation, Cross Correlation and Power Spectral Density of Narrow band fading model.

(5+5)

3A. 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 1μW at a reference distance of 1 km. Find the received power in dBm at 2 km and 10 km distances for the path loss models (i) Free Space (ii) $\gamma = 3$ (iii) Extended Hata model for larger cities.

3B. Write descriptive note on Diversity. With relevant diagrams, explain the Alamouti scheme of transmitter diversity in the absence of CSI at transmitter.

(6+4)

4A. For a cellular system the reference distance for the antenna far field is 100 m and the path-loss exponent is a random variable taking on values 2, 2.5, 3 and 4 with probabilities 0.4, 0.3, 0.2 and 0.1 respectively. Assume a receiver at a distance of 1000 m from the transmitter with average transmit power constraint of 100 mW and a receiver noise power of 1mW. (i) Assuming that both transmitter and receiver have CSI, find the distribution of the received SNR (ii) Assuming only receiver CSI, determine the ergodic capacity per unit bandwidth for this channel (iii) Assuming both receiver and transmitter CSI, derive the optimal power adaptation policy for this channel and its corresponding Shannon capacity per unit bandwidth (iv) Assuming both receiver and transmitter CSI, determine the zero outage capacity per unit bandwidth of this channel.

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

(6+4)

5A. Explain Power Delay Profile. The multipath intensity profile for a particular channel is given by $A_c(\tau) = \exp(-\tau/0.00001)$ for $0 < \tau < 20$ μs and zero elsewhere. Find the mean and RMS delay spreads of the channel and find the maximum symbol rate such that a linearly modulated signal transmitted through this channel does not experience ISI.

5B. 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 $\rho = 70$ Hz and $\alpha_2\, \delta(\tau - 0.022\mu s)$ at $\rho = 49.5$ Hz. If the transmitter and receiver are located 800 cm above the ground, (i) Find the velocity and distance between the transmitter and receiver. (ii) By what factor the path loss is varying with distance (iii) will a 30 KHz voice signal transmitted over this channel experience frequency selective or flat fading?

(5+5)