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Question Paper Code:U2209

M.E. DEGREE EXAMINATION, APRIL/ MAY 2025

Second Semester

Communication Systems

21PCM209- ADVANCED WIRELESS COMMUNICATION

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 20 = 100 Marks)

1. (a) (i) Elaborate on the term “Electromagnetic waves propagates through environments”. CO1- U (8)
- (ii) “All the transmitted and received signals we consider are real”. CO2-App (12)
Develop transmit and receive signal model for wireless communication channels by assuming complex frequency response.
- Or
- (b) (i) Consider a signal $s(t)$ transmitted through time varying channel. CO1- U (8)
Derive an expression for free space path loss gain.
- (ii) Apply the concept of propagation of EM signal in wireless communication channel, develop two ray model in which a single ground reflection dominates the multipath effect. Derive an expression for the transmitted and received signal power CO2-App (12)
2. (a) Consider a flat fading channel with i.i.d. channel gain $g[i]$, with a bandwidth of 30KHz and three possible received SNRs: $\gamma_1=0.833$ with $p(\gamma_1)=0.1$, $\gamma_2=83.33$ with $p(\gamma_2)=0.5$ and $\gamma_3=333.3$ with $p(\gamma_3)=0.4$. CO4-Ana (20)
- (i) Find the ergodic capacity of this channel assuming both transmitter and receiver have instantaneous channel side information.
- (ii) Find the zero-outage capacity of the channel.

Or

- (b) Consider a time-invariant frequency selective block fading channel consisting of three subchannels of bandwidth $B=1\text{MHz}$. The frequency response associated with each channels is $H_1=1$, $H_2=2$ and $H_3=3$. The transmit power constraint is $P=10\text{mW}$ and the noise PSD is $N_0=10^{-9}\text{ W/Hz}$. Find the Shannon capacity of this channel and the optimal power allocation that achieves this capacity. CO4-Ana (20)
3. (a) “In receiver diversity the independent fading paths associated with multiple receive antennas are combined to obtain a resultant signal that is then passed through a standard demodulator.” Analyze the receiver diversity combining techniques. CO3- App (20)
- Or
- (b) “Selection combining for systems that transmit continuously may require a dedicated receiver on each branch to continuously monitor branch SNR.” Name the combining technique which avoids the need for a dedicated receiver to monitor the SNR and Analyze its outage probability P_{out} . CO3- App (20)
4. (a) Explain in detail about Spatial Multiplexing and BLAST Architecture with appropriate diagrams. CO1-U (20)
- Or
- (b) Discuss about rank and determinant criterion for space time coding and explain the concept of space time trellis and block codes. CO1-U (20)
5. (a) A multiuser channel refers to any channel that must be shared among multiple users. Analyze two different types of multiuser channels namely the uplink channel and the downlink channel. CO5-Ana (20)
- Or
- (b) Consider an AWGN broadcast channel with total transmit power $P=10\text{mW}$, $n_1=10^{-9}\text{ W/Hz}$, $n_2=10^{-8}\text{ W/Hz}$ and $B=100\text{Hz}$. Suppose user 1 requires a data rate of 300Kbps . CO5-Ana (20)
- a) Find the rate that can be allocated to user 2 under fixed power time division, equal bandwidth frequency division and superposition coding.
- (b) Find the sum-rate capacity of the above system