METCE First Year 2024
Second semester
Wireless and Mobile Communication Systems

Full marks: 100   **Time: 3 hours**

Answer **Q. No 1** and **any four from the** rest
Answer must be written at one place for each attempted question

Q.1 Answer all questions: 7x2 +6 =20

a. The most widely used technology for cellular communication all over the world is AMPS/GSM- choose the right answer with reason.
b. WCDMA and CDMA2000 are not compatible technology-explain.
c. EDGE is the evolution of GPRS with a difference- compareand contrastthe two systems.
d. GPRS billing system is users friendly than GSM- Why?
e. Write advantages of using hexagonal cell structure over square one.
f. Give example technology standards for personal area network, local area network and wide area network.
g. What is IEEE 802.11x meant for?

(h) Draw the very basic Cellular communication network architecture. Then explain how channel is established between two mobile users situated widely apart cells within same city.

Q.2 (a) Establish the formula for determining the size of a cluster 'N' by drawing cellular array and designating parameters used in establishing the formula. Explain what is called co-channel distance D.

(b) How is q=D/R related with S/N ratio? How does 'q' influence frequency reuseplanning?

(c) In a cellular communication system with 550 voice duplex channels the entire service area is divided into 152 cells. The required S/N (signal to co-channel interference ratio) is set 15 dB at least. The path loss exponent k=3, determine,

(i) The cell cluster size (ii) The number of clusters in the service area (iii) The maximum number of users in the service area at any instant.
(d) If the path loss exponent k is made to 4, then what will be the modified cluster size N? Explain your answer.   8+5+5+2

Q.3 (a) Discuss the different channel assignment scheme in cellular network. Explain when to use fixed channel and dynamic channel assignment. Which will be the best among all the channel assignment schemes you have listed?
(b) Give pictorial representation of handoff process due to user movement in cellular communication. Discuss about hard and soft handoff.
(c)Two base stations BS1 and BS2 in a cellular system are separated by a distance 2000m. A mobile station MS is close to BS1 moving in a straight line towards BS2.The received power Pr at the base

station i from the MS in the uplink followed the log distance path loss model neglecting small scale fading as,

$$P_{r,i}(d_i) = P_0 - 10 \, k \log_{10} (d_i / d_0) \, (dBm), \, i=1,2$$

Given at d_0 the received power $P_0 = 0$ dBm, path loss exponent is k=3, $P_{r,min}$ = minimum signal level for accepting voice quality is -90 dBm, the handoff threshold level $P_{r, HO}$ is used to trigger handoff. Time to complete the handoff is 4.5 sec. Determine the minimum required handoff margin $\Delta = P_{r, HO} - P_{r, min}$ such that call will not be lost.

Discuss the effect of Δ on handoff, if it is low enough and large enough. You may assume data of your choice if requires.   6+6 +8

Q.4 (a) Explain how arefrequency selective, frequency non-selective fading, fast and slow fading occurred in cellular communication.

(b) Considering multipath propagation, find the time varying channel impulse response.

Draw the sampled value of channel impulse response w.r.t 'τ'.

(c) Now write the expressions for channel transfer function, Doppler spread function and Delay Doppler spread function.

(d) A WSSUS channel has a multipath delay spread T_m =1 s and a Doppler spread of f_d= 2 Hz. The total channel bandwidth at band pass available for signal transmission is W= 500Hz. To reduce the effects of ISI, the signal designer selects a symbol duration T_s=10 s.

i. Determine the coherence bandwidth and the coherence time

ii. Does the channel exhibit frequency selective fading? Explain

iii. Does this channel exhibit slow and fast fading? Explain.

iv. Determine the transmission data rate of the system.   5+3+6+6

Q.5 (a) From the time varying channel impulse response of type WSS find the scattering parameter $S_c(t,\tau)$. How is Power-delay profile related to scattering parameter.

(b) The discrete power profile delay for multipath transmission is shown in the figure, determine the multipath power gain, mean delay and rms delay spread.
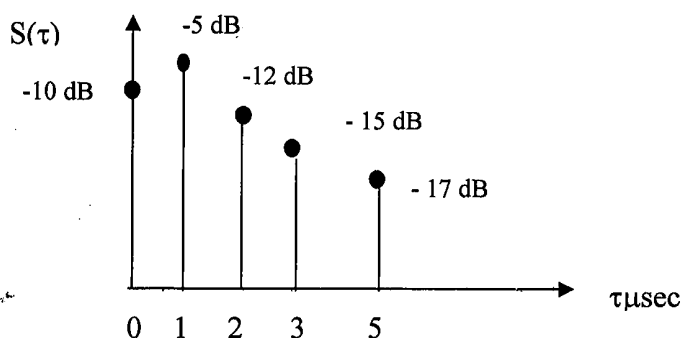
(c) How is outage probability under path loss and shadowing defined? Explain its significance.

(d) Consider a fading channel which exhibits a doppler frequency shift uniformly distributed over -5 to +5 Hz. Determine the mean doppler shift, rms doppler spread and the coherence time.

5+5+4+6

Q6. Discuss space diversity in wireless communication. What are the 3 mostly used space diversity techniques. Will there be any relation of space diversity with MIMO system?

(b) Show how is capacity increased in 2x2 MIMO channel.

(c) Explain the narrowband TDMA access method in GSM system. Calculate the spectral efficiency for narrow band TDMA.   5+ 8+7

Q7.(a) Draw the network architecture for 3G WCDMA and 3G LTE system. What are the basic evolutionary changes for LTE?

(b) What are the key technologies used for 4G LTE for improved performance. Outline the achieved performance for 4G in terms of speed, latency, spectrum use, coverage and mobility.

(c)5G is the most discussed topic in recent times. What is the key technology jump for 5G to realize throughput and latency.

(d) Fill in the blanks:

(i) Bluetooth wireless technology is a _____ *radio technology*, which is developed for _____ Network.

(ii) The two types of topologies for Bluetooth are _____ and _____.

(iii) The **Radio** layer defines the requirements for a Bluetooth transceiver operating in the _____ GHz ISM band.

(iv) The _____ **Protocol** is used by the Link Managers (on either side) for link set-up

(v) The _____ protocol provides emulation of serial ports over the L2CAP protocol. and control.   5+5+5+5

Q.8 Write short notes: any 2   10x2=20

(a) GPRS Mobility and session management
(b) Direct sequence spread spectrum method
(c) WLAN MAC protocol