VIT
Vellore Institute of Technology

School of Electronics Engineering
Fall 2024-25
CAT I
Programme Name & Branch: B.Tech - ECE
Wireless and Mobile Communications (BECE307L)

Slot: A2 **Exam Duration: 90 mins** **Maximum Marks: 50**

Instructions:

- Answer all the questions
- Erlang B, Erlang C, Q Tables, and Okumura charts are permitted.
- Assume suitable values for any missing variables.

Q1.

a) Describe with the help of a clear schematic how the capacity of a cellular system can be enhanced by introducing new cells with lower transmitter power. Also, explain the relationship between the transmitter power of the new cells and that of the original cells. **(5)**

b) Find the Signal-to-Interference (S/I) ratio for the mobile user with and without sectoring (120^o) by considering a cluster size of 7. Does sectoring improve the capacity of a cellular system? **(5)**

Q2.

a) Consider an outdoor small cell with f_C =2.5 GHz, cells of radius 10 m, and isotropic antennas. Under the free-space path loss model, what transmit power is required at the base station in order for all terminals within the cell to receive a minimum power of 0.1 μW? How does this change if the system frequency is 5 GHz? **(5)**

b) Determine the propagation path loss for a radio signal at 800 MHz with a transmitting antenna height of 50 m and a receiving antenna height of 3 m. over a distance of 15 km, using two ray path loss model. How is it comparable with that of free space propagation path loss model? **(5)**

Q3. A certain city has an area of 1,300 square kilometers and is covered by a cellular system using a 7-cell reuse pattern. Each cell has a radius of 4 kilometer and the city is allocated 40 MHz of spectrum with a full duplex channel bandwidth of 60 kHz. Assume a GOS of 2% for an Erlang B system is specified. If the offered traffic per user is 0.03 Erlangs, compute

(5 X 2=10)

i. The number of cells in the service area
ii. The number of channels per cell
iii. Traffic intensity of each cell
iv. The maximum carried traffic
v. The total number of users that can be served for 2% GOS.

Q4. a) Assuming metropolitan city, employ the Hata propagation model at 1800 MHz and 2.4 GHz respectively, to determine maximum coverage distance of each cell, before having path loss greater than 150 dB, provided cell site antenna height of 75 m and a mobile antenna height of 2 m. (8)

b) If free space path loss is 110 dB, comment on your finding on the estimated path loss across two models. (2)

Q5. A drone is flying at a speed of 30 m/s and communicating at a carrier frequency of 2.4 GHz.

(5 X 2=10)

i. Calculate the Doppler spread B_D for the channel.
ii. Determine the spatial sampling interval required to make small-scale propagation measurements.
iii. How many samples will be needed to cover a distance of 15 meters?
iv. If these measurements can be made in real-time, how long will it take to cover the 15 meters?
v. If the signal bandwidth is 10 MHz, how will the Doppler spread affect the channel's performance?