

**BETCE Final Year 2019**  
**Second Semester**  
**Subject: Wireless Communication Systems**

**Time: 3 hours**

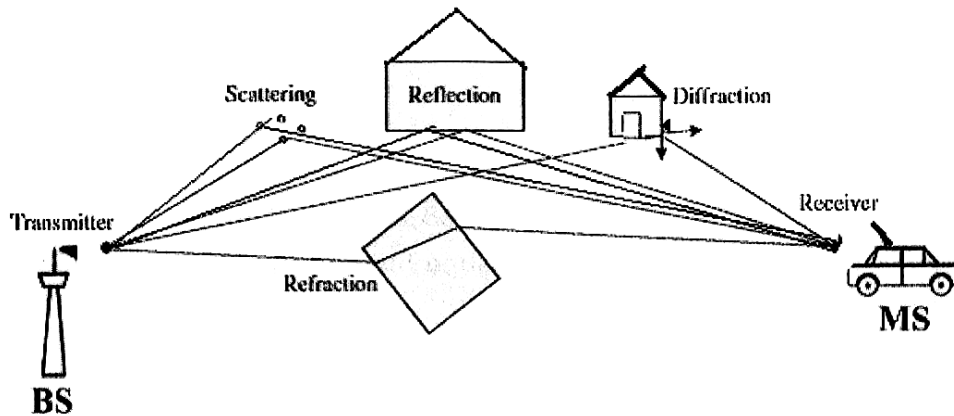
**Full Marks: 100**

**Answer all Five questions each carries 20 Marks (mention question No. with OR if you attempt any question with OR)**

**Answer must be written at one place for each attempted question, marks will be deducted for not following this instruction**

- Q1. A)** AT & T and Bell introduced the first commercial mobile telephone system in the year \_\_\_\_\_ launched at Missouri in US with \_\_\_\_\_ MHz Bandwidth and three channels with \_\_\_\_\_ kHz channel spacing.
- B)** The scientific basis of wireless communication built with the work of \_\_\_\_\_ and \_\_\_\_\_ to send and receive Morse Code – Based on long wave, spark transmitter technology, requiring very - \_\_\_\_\_ power transmitters.
- C)** Cellular wireless mobile services were first made available in \_\_\_\_\_ in the Year \_\_\_\_\_.  
2+2+1
- D)** Write 5 basic wireless communication challenges. 05
- E)** Prior to cellular communication, single base transmitter was used over large areas– What were the difficulties faced for that system? 03
- F)** Cellular array is linked with frequency reuse technique –what are the scientific bases of frequency reuse within a geographical area? 03
- G)** If Signal to Noise ratio of 15 dB is required for satisfactory forward channel performance in a cellular system with 6 neighbour cells what is the frequency reuse factor and cluster size to provide maximum capacity if path loss exponent is 3. 04
- Q2. A)** The following figure describes the phenomena in wireless mobile communication path between Base Station (BS) and Mobile Station (MS). What will be the possible effects may occur at the receiving end. What will be the probable distribution of received signal? Describe the model. 2+5

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B) In part (A), now imagine there is always a significant direct LOS component - how the received signal distribution will change? Discuss the effect of increasing signal strength of LOS components from 0 dB to 20 dB. Show the pictorial representation. 07

C) Discuss when the following path loss models will be used.

i. Free space path loss, ii. Log-distance model, iii. Log-normal shadowing: Give expressions for each model. 06

**OR**

Q2. A) By drawing the two ray ground reflection model, explain the advantages and disadvantages of this model in analysis of path loss. 04

B) Prove that in the two-ray path loss model the path difference  $\Delta = d_1 - d_2$ , is approximated to  $2h_t h_r / d$ , where symbols have their usual meaning. 04

C) If  $h_t = 35$  m,  $h_r = 3$  m,  $d = 250$  m, find whether the two-ray model could be applied. Give reason for your answer. 05

D) Suppose you get an assignment to perform a measurement campaign to estimate the channel loss component for a new wireless product. You performed field measurements and collected the following data:

Reference path loss:  $PL_0(d_0)$

Path loss measurements:  $PL_1(d_1), \dots, PL_n(d_n)$ , at distances  $d_1, d_2, \dots, d_n$

Using the log-distance path loss model, find the expression for the optimum value of the path loss exponent ' $\kappa$ ', which minimizes the mean square error between measurements and the model. 07

**Q3. A)** Discuss the fading effects due to Multipath Time Delay Spread and Doppler Spread. From the discussions define the coherence time and coherence bandwidth. 06

**B)** If maximum allowable excess delay for a wireless communication is 5 microsec, and the rms delay spread measured for a multipath propagation is 1.37 microsec, what types of fading will occur? Find the Coherence Bandwidth for this. Will it be applicable for GSM system with channel spacing 200 kHz without equalizer use? 05

**C)** What will be the symbol duration and transmitted bit rate for problem part (B) if BPSK modulation is used? 02

**D)** The local average power delay profile in a particular environment is found to be

$$P(\tau) = \sum_{n=0}^2 [10^{-6} / (n^2 + 1)] \delta(\tau - n10^{-6})$$

(i) Sketch the power Delay Profile of the channel in dBm

(ii) What is the rms delay spread ( $\sigma_\tau$ ) of the channel?

(iii) If the channel is to be used with a modulation that requires an equalizer whenever the symbol duration  $T$  is  $10\sigma_\tau$ , determine the maximum RF symbol rate that can be supported without requiring an equalizer.

(iv) If a mobile travelling at 30 km/hour receives a signal through the channel, determine the time over which the channel appears stationary (or at least highly correlated). 07

**Q4. A)** Second generation GSM cellular network uses TDMA that shares a single carrier frequency with several users where each user uses non-overlapping time slots. Draw the TDMA frame - slot structure. 03

**B)** Now if GSM system uses 25 MHz forward link with channel spacing 200 kHz and 8 speech channels are supported on a single radio channel without guard band, find the number of simultaneous users can be accommodated in GSM.

If GSM frame consists of 8 time slots of 156.25 bits, data transmission rate 270.833 kbps in the channel, find one slot and frame duration. How long a user has to wait for two successive transmissions? 05

**C)** If there is 6 trailing bits, 8.25 guard bits, 26 training bits and two traffic burst of 58 bits of data, find the GSM frame efficiency? 03

**D)** Highlight 3 advantages and 3 disadvantages of TDMA system. 04

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E) Describe the Direct Sequence Spread Spectrum CDMA technique and define processing gain. Channel data rate is high in CDMA-how? 05

**Q5.** A) Categorize which of the following systems are meant for voice, data and multimedia communication.

AMPS, DECT, IS-95, GSM, GPRS, EDGE, UMTS, CDMA-2000, LTE 03

B) Show with pictorial representation the evolutionary development of GSM to GPRS networks for data communication. What are the new nodes and interfaces required for this development? What are the benefits of GPRS network over GSM? 07

C) Justify the following statements: 10

- i) FDMA and TDMA are bandwidth limited where as CDMA is interference limited.
- ii) Soft Handoff management is easier for CDMA network.
- iii) When threshold is too small for handoff initiation, drop call is the result.
- iv) Performance of network depends on both cell residence time and call holding time of a mobile user.

**OR**

Q5. A) Why is PDP context required in GPRS network? Show that using different identifiers for each PDP context, data is rightly transferred over GPRS network. 05

B) Give the continuous enhancement of UL and DL data rates from R99 to R8 and tag each releases with UMTS, HSDPA, HSUPA, HSPA<sup>+</sup> 05

C) Justify the following statements: 10

- i) Cell sectoring is one of the important ways for capacity enhancement in cellular system.
- ii) Large location area decreases cost of location update and increases paging cost.
- iii) Static channel assignment schemes perform well under heavy traffic conditions.
- iv) Channel interleaving is important to avoid adjacent channel interference