

**BITS PILANI, DUBAI CAMPUS**  
**II SEMESTER 2011 – 2012 COMPREHENSIVE EXAMINATION**  
**IV year – ECE/EEE/EIE**

Course Code: EA C452

Course Title: MOBILE TELECOMMUNICATION NETWORKS

Duration: 3 Hrs

Date: 07.06.2012

Max.Marks:80

Weightage: 40%

- Instructions:**
1. ANSWER all questions in sequence of their order.
  2. Make assumptions, if any, but explicitly indicate the assumptions made

1. a) Draw Algorithmic flow chart which shows how a cellular telephone call is made between two mobile users **5M**
- 5M**
- b) Draw timing diagram for call establishment between mobile user and land line .
2. a) Derive expression  $N=i^2 + i.j + j^2$  .Why is it required in cellular mobile communication systems? What is the value of N used in mobile communication in general? Derive the required value N from C/I expression .If 20 MHz of total spectrum is allocated for a duplex wireless cellular system and each simplex channel has 25kHz RF bandwidth, find total number of duplex channels available in the system and total number of channel per cell site for the value of N. **10M**
3. The base station transmitter power is changed from  $P_{t1}$  to  $P_{t2}$  where as receive power at mobile is changed from  $P_{r1}$  to  $P_{r2}$ . Prove that the radius of a new cell
- $$r_2 = \left( \frac{P_{r1} P_{t2}}{P_{r2} P_{t1}} \right)^{\frac{1}{4}} r_1 .$$
- Analyze the result
- (i) to increase the radius by 2 times and
  - (ii) to decrease the radius by  $\frac{1}{2}$  times.
  - (iii) Why is it required to have these two conditions?
4. A hexagonal Cell within four cell system has a radius of 1.387 km .A total of 60 channels are used within the entire system. If the load per use is 0.029 Erlangs and call request rate  $\lambda =1$  call. Compute following for an Erlang C system that has a 5% probability of delayed call **10M**
- i) How many user per square kilometer will this system support
  - ii) What is the probability that a delayed call will have to wait for more than 10 S
  - iii) What is the probability that a call will delayed for more than 10 seconds
  - iv) Find out the power, E field and rms voltage applied at mobile receiver located at 10 km from 50 watts,6 GHz base station transmitter if this mobile communication system employs 50  $\Omega$  pure resistance antenna having  $G_t = 0\text{dB}$  and  $G_r=0\text{dB}$  .

5. Derive the expression for phase changes due to path difference in two paths established by Fresnel diffraction and calculate the value of the same if  $d_1=1\text{km}$  and  $d_2=1\text{km}$  and  $h=25\text{m}$ . Assume the frequency of transmission as 900 Mhz. **10M**
6. An FM signal with a frequency deviation of 10kHz at a modulation frequency of 5kHz is applied to two frequency multiplier connected in cascade. First multiplier doubles the frequency and the second multiplier triples the frequency, Determine the frequency deviation and modulation index of FM signal obtained at second multiplier output. What is the frequency separation of adjacent side frequencies of this FM signal **5M**
7. a) Why GMSK is preferred for mobile communication? Draw GMSK transmitter and receiver. Derive the expression  $S_{MSK}(t) = \sqrt{\frac{2E_b}{T_b}} \cdot \cos[2\pi f_c t - m_I(t) \cdot m_Q(t) \frac{\pi t}{2T_b} + \phi_k]$  of modulated signal. **10M**
- b) Determine the number of channels per cell for case of (i)  $n=3$  propagation path loss and (ii)  $n=4$  propagation path loss if minimum C/I is 14dB. Find the cluster size of cellular system if channel bandwidth is 30kHz and spectrum allocation is 20MHz.
8. Write short notes on **15M**
- (i) MAHO
  - (ii) Diversity
  - (iii) FHSS

\*\*\*\*\*GOOD LUCK\*\*\*\*\*

**BITS PILANI, DUBAI CAMPUS**  
**II SEMESTER 2011 – 2012**

Course Code: EA C452

TEST-2[Open Book]

Date: 30.04.2012

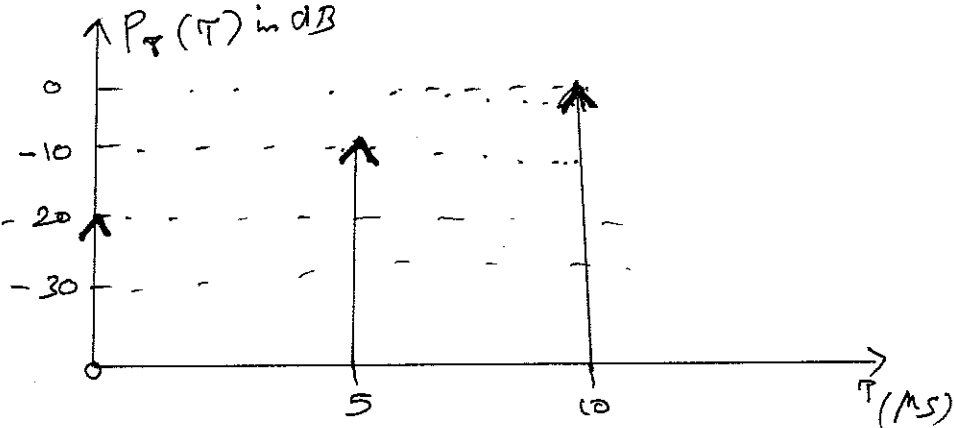
Course Title: MOBILE TELECOMMUNICATION NETWORKS

Max.Marks:40

Duration: 50 minutes

Weightage: 20%

- Instructions:** 1. ANSWER all questions in sequence of their order.  
 2. Make assumptions, if any, but explicitly indicate the assumptions made

1.	<p>a) In the following cases explain why or why not two ray model could be applied (i) <math>h_t = 35m</math> <math>h_r = 3m</math> and <math>d = 250m</math> and (ii) <math>h_t = 30m</math> <math>h_r = 1.5m</math> and <math>d = 450m</math>.</p> <p>b) Prove that the path loss exponent for mobile communication is 4 in general.</p>	<p>4M</p> <p>4M</p>
2.	<p>a) The transmitting antenna at base station having height of 25m emits signal at 900 MHz. This signal is subjected to knife edge diffraction at an altitude 50m at point 10 km away from base. The receiver at a distance of 12 km from base is located at an altitude of 12.5m. Derive the expression for phase difference and calculate the same.</p> <p>b) If mobile phone transmits 1mwatts of power at a frequency of 900Mhz through an antenna having 0dB from a distance of 5km. The receiver power at base is <math>10\mu</math>watts. Design downlink of this cellular system</p>	<p>6M</p> <p>4M</p>
3.	<p>Find the RMS delay spread for the following power delay profile and coherence bandwidth</p> 	4M
4.	<p>a) Given that the probability density function of Rayleigh distributed envelope is given by <math>p(r) = \frac{r}{\sigma^2} \exp\left(-\frac{r^2}{2\sigma^2}\right)</math>. Find the expression for <math>p(r &lt; R)</math>. Find the percentage of time that a signal is 10 dB or more below the RMS value for a Rayleigh fading signal.</p> <p>b) Assume a SNR of 25 dB required at the receiver. If a 900 MHz cellular radio transmitter has an EIRP of 100 w, and the AMPS receiver uses a 0dB gain antenna and has 10dB noise figure. Find the percentage of time achieved at a distance of 10km from the transmitter. Assume <math>n=4</math>, <math>\sigma=8</math>dB and <math>d_0=1</math>km.</p>	<p>6M</p> <p>6M</p>
5.	<p>a) The AM signal <math>S(t) = A_c[1+k_a m(t)] \cos(2\pi f_c t)</math> is applied to square law modulator. Assume that <math>[k_a m(t)] &lt; 1</math> for all value of t and message signal <math>m(t)</math> is limited to the interval <math>-W \leq f \leq W</math> and that the carrier frequency <math>f_c &gt; 2W</math>. Show that <math>m(t)</math> can be obtained from output of square – rooter circuit.</p> <p>b) If modulating signal <math>m(t) = \cos \omega_m t</math> is modulated by carrier <math>c(t) = \cos \omega_c t</math> by using product modulator. Write how to get back <math>m(t)</math> from modulated signal. Prove it</p>	<p>4M</p> <p>2M</p>

# BITS PILANI, DUBAI CAMPUS

II SEMESTER 2011 – 2012

Course Code: EA C452

TEST-1

Date: 112.03.2012

Course Title: MOBILE TELECOMMUNICATION NETWORKS

Max.Marks:50

Duration: 50 minutes

Weightage: 25%

**Instructions:** 1. ANSWER all questions in sequence of their order.  
2. Make assumptions, if any, but explicitly indicate the assumptions made

1.	a) Draw Mobile phone block diagram and explain each block. b) Draw timing diagram for establishing a call between two mobile user.	[4 M] [6 M]
2.	Obtain the expression $N = i^2 + j^2 + i.j$ and prove that frequency reuse factor $\frac{D}{R} = \sqrt{3N}$	[8 M]
3.	a) Why is Hexagon considered for cellular structure? Prove it b) Discuss issues related with handoff implementation	[8 M]
4.	Assume each user of a single base station mobile radio system averages three calls per hour, each call lasting an average of 5 minutes. a) What is traffic intensity for each user? b) Find the number of users that could use the system with 1% blocking if only one channel is available c) Find the number of users for 1% blocking and 5 channels d) If the number of users is doubled what is the new blocking probability? e) Write your comment on performance of system new blocking probability	[8 M]
5.	Cellular mobile system has to be split. If the power at mobile receiver and base receiver is $P_r = 0.1$ mW and power transmitted by base is reduced from $P_t = 10$ watts to 5 watts. Find out cell radius of new cell	[4M]
6.	A certain city has an area of 2330 sq.km and is covered by using a 7 cell reuse pattern cellular system. Each cell is of radius 3 km. The city is allocated to use 25MHz of spectrum with a full duplex channel bandwidth of 60kHz. Assume a GOS of 2%. Erlangs B system is specified. If the offered traffic per user is 0.01 Erlangs, Compute (a) number of cells in the service area, (b) the number of channels per cell, (c) traffic intensity of each cell, (d) the maximum carried traffic, (e) the total number of users that can be served for 2% GOS, (f) the number of mobile per channel and (g) theoretical maximum number of users that could be served by the system.	[12 M]

Date: 21<sup>st</sup> May 2012

Evaluation Component : QUIZ-2

Max. Marks: 14

Duration: 20 mts

EA C452 MOBILE TELECOMMUNICATION

Weightage: 7%

Note:- 1. ANSWER ALL QUESTIONS

2. Make assumptions, if any, but explicitly indicate the assumptions made

1. Write any two reasons for selecting FM modulation for mobile communication [2]
  
2. AMPS standard has an upper bound of 32 kHz and a lower bound of 24 kHz for channel bandwidth. Write the expression used for it and find out value of associated parameters [2]
  
3. Calculate modulation index and peak frequency deviation if a sinusoidal signal  $m(t) = 4 \cos(2\pi \cdot 4 \cdot 10^3 t)$  is applied to an FM modulator which has a frequency deviation constant gain of 10kHz/V. [2]
  
4. Write factors that influence the choice of digital Modulation [1]

5. What is length of PN code if 8 bits linear shift register is employed for Spread Spectrum modulation [1]
6. Why MSK is preferred for mobile communication [1]
7. Write the difference between multiplexing and multiple access [2]
8. What is the advantage of CDMA over FDMA and TDMA [2]
9. Compare M-ary FSK with Frequency Hopping spread spectrum techniques [1]

NAME:

ID NO:

Version A

**BITS-Pilani Dubai Campus, Dubai International Academic City**

**IV YEAR ECE/EEE/EIE**

**Evaluation Component : QUIZ-I**

**EA C452 MOBILE TELECOMMUNICATION**

**Date: 8<sup>TH</sup> FEB 2012**

**Duration: 20 mts**

**Max. Marks: 16**

**Weightage: 8%**

Note:- 1. ANSWER ALL QUESTIONS  
2. Make assumptions, if any, but explicitly indicate the assumptions made

1. Differentiate adjacent channel interference and co channel interference. **[2 Marks]**
  
  
  
  
  
  
  
  
  
  
2. Why is paging channel required for mobile communication? **[2 Marks]**
  
  
  
  
  
  
  
  
  
  
3. Convert 0.0001 watts into dBm watts **[1 Marks]**
  
  
  
  
  
  
  
  
  
  
4. Define Quality Of Service (QOS)? **[1 Marks]**
  
  
  
  
  
  
  
  
  
  
5. Calculate cluster size and D/R ratio of cellular mobile communication system if  $C/I=16\text{dB}$  if path loss exponent is 4 **[2 Marks]**

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6. Calculate frequency reuse distance if  $C/I = 15\text{dB}$ . Assume the radius of cell is  $2\text{km}$  [2 Marks]
7. Calculate the value of  $C/I$  if the particular mobile communication system employs  $Q=4.43$  and the transmitter is located at edge with omni directional transmission. [2 Marks]
8. Calculate frequency reuse distance if the cellular system has cell radius of  $1\text{ km}$ ,  $i=2, j=2$  [2 Marks]
9. In a Erlang C system, what is the probability that a delayed call will have to wait for more than  $20\text{s}$  if load per user is  $0.029$  and call arrival rate is  $1\text{ call }/30\text{ minutes}$  and no of channel per cell is  $15$ . [2 Marks]