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B.Sc./ HD CIT 5th Semester 12 May, 2011 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
THE ORGANIZATION OF THE ISLAMIC CONFERENCE (OIC)
Department of Computer Science and Information Technology (CIT)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2010-2011**
Duration: 3 Hours **Full Marks: 150**

CIT 4503: Communications Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.

There are 8 **(eight)** questions. Answer any 6 **(six)** of them.
Figures in the right margin indicate marks.

1. a) What is a communication system? What are the advantages of digital communication over analog communication? 5
   b) Explain frequency hopping and direct sequence CDMA with suitable example. 15
   c) Suppose the capacity of a communication link is 20 kbps and bandwidth is 1.38 MHz. What will be the required SNR according to Shannon's capacity formula? 5

2. a) Briefly describe the special issues to be considered for designing a radio system. 7
   b) Draw the GSM architecture and explain concisely. 10
   c) Show the process of constructing a GSM frame of 156.25 bits by using channel coding and interleaving. 8

3. a) Explain the way of constructing the speech multiframe and control multiframe structure in GSM standard. 9
   b) How different logical channels are assigned and released when a call is originated from a PSTN and terminated to a mobile station? 8
   c) Describe the interleaving and ciphering phases in GSM signal processing. 8

4. a) Briefly discuss the architecture of a satellite communication system. 10
   b) What do you understand by GPS and GNSS? Give applications of GNSS and mention some GNSS systems maintained by different countries of the world. 7
   c) Consider that a vehicle is moving in 40 m/s where the carrier frequency is 900 MHz and rms delay spread is 3μs. What will be the maximum Doppler shift? Calculate coherence time and coherence bandwidth. If symbol rate is 15 kbps and system bandwidth is 900 KHz, then find out what kind of symbol distortion and fading will be experienced? 8

5. a) Explain the followings: i. Time dispersion ii. Frequency dispersion iii. Coherence Time iv. Coherence Bandwidth v. Thermal noise 10
   b) What do you understand by frequency flat/selective and time flat/selective channel? Which one is desirable for reliable communication and why? 5

c) The speech quality for a mobile communication system is just acceptable, when the received power at the terminals of the mobile receiver is -85 dBm. Find the maximum acceptable propagation loss for the system when the transmit power at the base station is 50 W, base station feeder losses are 5 dB, base station antenna gain is 3 dB. Antenna gain of the mobile is 1 dB and feeder losses at the mobile are 2 dB. Calculate the maximum range of the system using 10

i. the free space loss model, and
ii. the plane earth loss model, assuming a frequency of 900 MHz and antenna heights of 15 m and 1.5 m.

6. a) Why do we need propagation models? Explain the scenario required to choose among Free Space model or Empirical model or Deterministic model in order to model path loss efficiently. Give example for each of these models. 9

b) What are the ways to increase capacity and coverage of a cellular system? 6

c) Consider a GSM 900 MHz system with base station antenna height of 35 m and mobile station antenna height of 1.5 m and the distance between them is 6000 m. Calculate the path loss using Two-Ray model and Okumura-Hata model in a medium sized city. 10

7. a) Briefly explain the types of interference that can occur in a cellular system. How can we minimize them? 7

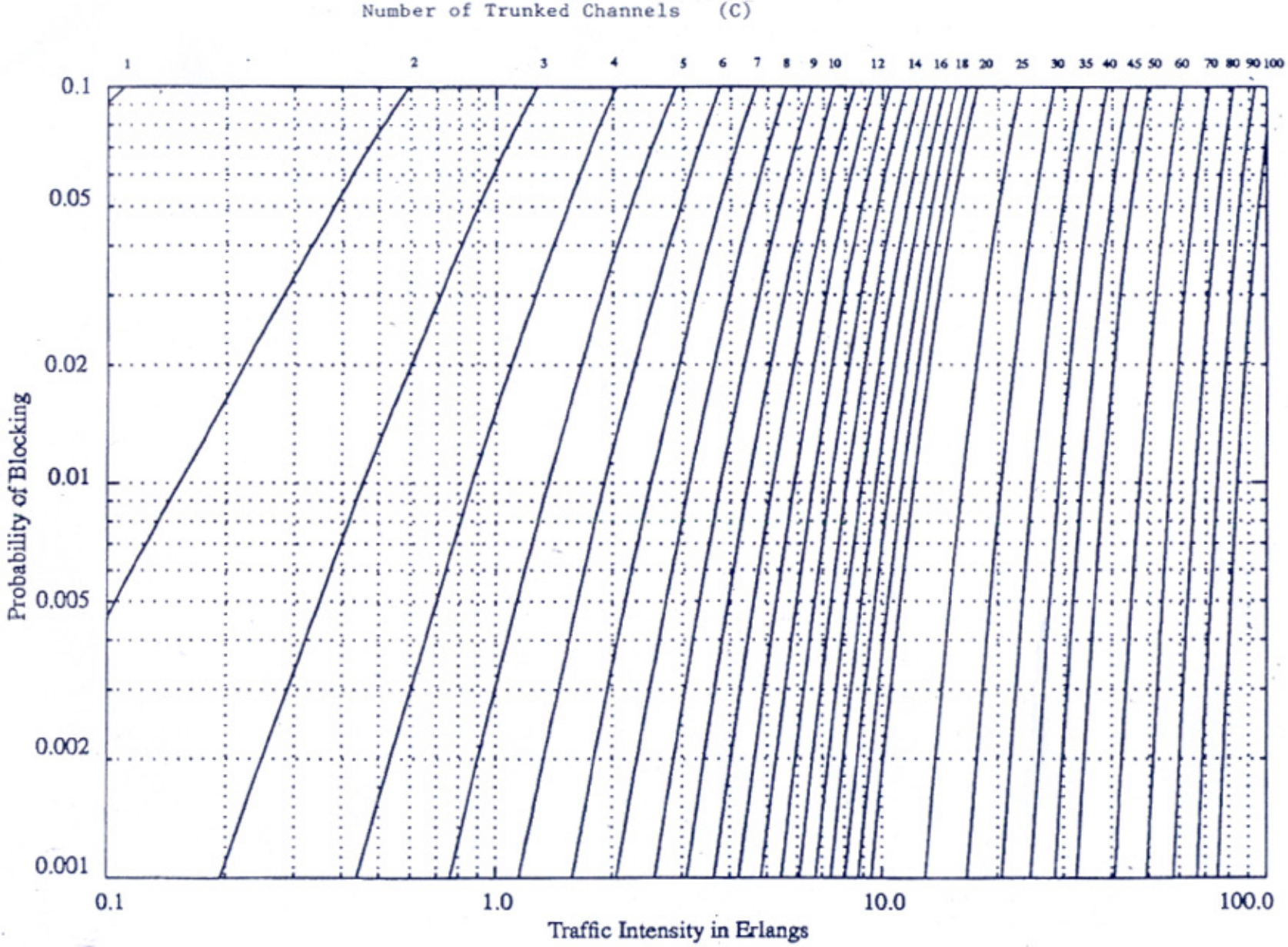
b) Define: i. Receiver sensitivity ii. Doppler shift iii. Guard channel iv. Umbrella cell. 8

c) A system has 120 traffic channels available where a minimum SIR of 15dB must be maintained. Consider that there are 6 channels in the first tier. Find the minimum cluster size and frequency reuse factor with path loss exponent 3. What will happen if path loss exponent n becomes 4? How cluser size and frequency are reuse factor affected by this change of path loss exponent? 10

8. a) What do you understand about Trunking and Grade of Service? How can you ensure Trunking efficiency? 6

b) What is cell splitting and sectoring? How can these techniques increase capacity? 9

c) A small city of 75000 residents has two competing mobile networks company named A and B that provide cellular service to the users. Company A has 50 cells, each with 40 channels and company B has 100 cells, each with 20 channels. Find the number of users that can be supported at 5% blocking probability if each user averages 2 calls per hour at an average call duration of 6 minutes. Compute the percentage market penetration of each company assuming that both the companies are operated at maximum capacity. **(The Erlang B chart is attached as an appendix).** 10


Number of Trunked Channels (C)
1
2
3
4
5
6
7
8
9
10
12
14
16
18
20
25
30
35
40
45
50
60
70
80
90
100
0.1
0.05
0.02
0.01
0.005
0.002
0.001
Probability of Blocking
0.1
1.0
10.0
100.0
Traffic Intensity in Erlangs