PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester II — Academic Year: 2009
Date: February 25, 2010 — Time: 13.30-16.30
Subject: 210-463 Telecommunication Engineering — Room: Robot

Instructions:

a. Allow a student to open his/her own note (**one A4-size paper only**) during the exam

b. Allow the student to use a calculator and dictionary

Attempt all problems

1. *Fiber-optic communications*

Below is the list of parameters for the fiber-optic communication link operating at 1330 nm wavelength to support the data rate of 140 Mbps. The desired BER is $1*10^{-9}$.

- The light source is a laser diode with a −0.3 dBm output.
- The optical fiber amplifier gain is 40 dB.
- The receiver threshold of a PIN type is −46 dBm.

a) Find the power budget

(5 points)

Allocate the power budget in a) as follows:

- Connectors are used at the output of the source and at the input to the detector. The connector loss is at 0.5 dB each.
- Fusion splices every kilometer; allows 0.25 dB per splice
- Fiber attenuation loss at 0.25 dB/km
- A margin of 4 dB

b) What will be the maximum distance achievable without the use of repeaters?

(5 points)

2. *Satellite communications*

Below is the link budget analysis for the uplink (6.175 GHz, C-band). Calculate this satellite link budget and answer Problems 2.1)-2.6).

2.1) Transmit power (850W) ☐ dBW
What is the transmit power in dBW?

Transmit waveguide losses	2.0 dB
Transmit antenna gain (7m)	50.6 dBi

2.2) Uplink EIRP ☐ dBW
What is the uplink EIRP in dBW?

Atmospheric attenuation	0.1 dB
Free-space loss	200.4 dB
Receive antenna gain	26.3 dBi
Receive waveguide loss	0.5 dB

2.3) System noise temperature (450K) ☐ dB(K)
What is the system noise temperature in dB(K)?

2.4) Spacecraft G/T ☐ dB/K
What is the Spacecraft G/T in dB/K?

Boltmann's constant	–228.6 dBW/Hz/K

2.5) Bandwidth (25 MHz) ☐ dB Hz
What is the bandwidth in dB Hz?

2.6) Carrier-to-noise ratio ☐ dB
What is the carrier to noise ratio in dB?

(10 points)

3. *Wireless communications*

3.1) Explain the advantages and disadvantages of cell clustering in Figure 1.
(5 points)

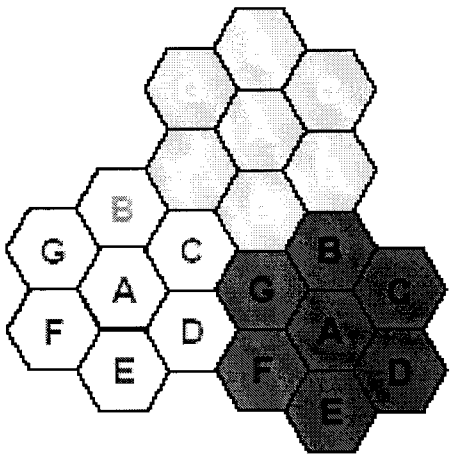

Figure 1

3.2) If the C/I of 15 dB is required for a satisfactory channel performance of a cellular system, what is the cluster size should be used for the maximum capacity if the path loss coefficient is $\alpha = 3$? Assume that there are 6 co-channel cells in the first tier, and all of them are at the same distance from the mobile. Use suitable approximations.

(10 points)

3.3) Consider AMPS with the C/I requirement = 18 dB. Implement this cellular system in a suburban propagation environment with the path loss coefficient (α) = 4. Calculate the maximum radio capacity of this analog cellular system. Given that the radio capacity is measured as "the number of traffic channels per cell per MHz."

(15 points)