Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2013-14 (2.0 hours)

EEE6430 Mobile Networks and Low-Level Protocols

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section. Where a symbol or abbreviation is not defined it can be assumed to have its usual meaning, with which candidates should be familiar.**

1. **a.** Explain how a mobile handset codes a 20ms speech block onto the traffic channel. You should quantify your description by including bit rates and data sizes at each stage. **(12)**

b. Describe how convolution coding is applied to the GSM data. **(4)**

c. If the input bit stream to the convolution encoder is 1011000110101, calculate the output of the encoder. **(4)**

2. **a.** Explain the DPDCH and DPCCH in the 3G WCDMA protocol. Your answer should include

(i) Diagrams of their timeslot and frame structures

(ii) The payload data they carry

(iii) A diagram of the uplink modulation chain

(iv) Typical bit rates **(12)**

b. If a spreading factor of 64 is used for the DPDCH, estimate

i) The uplink DPDCH symbol rate

ii) The uplink DPDCH bit rate

iii) The maximum uplink DPDCH data rate with ½ rate coding

iv) The downlink DPDCH bit rate **(8)**

3. **a.** A GSM BTS uses a vertically polarised co-linear dipole array with a gain of 20dBi to serve a particular cell in the 1800MHz band, with an instantaneous power of 10W for each timeslot burst in use. Estimate the minimum safe distance from the antenna in the direction of the (horizontal) main lobe so that the radiated power density level is within the safety limit of 100Wm^{-2}, assuming all timeslots are active. **(6)**

b. One of the sidelobes of the BTS array has a level of -26dB with respect to the main lobe at an angle of 60^{o} from the horizontal towards the ground. Assuming the antenna height is 7m, calculate the power density at ground level due to this sidelobe. **(6)**

c. Estimate the power density within a bedroom of a house at the same height as the BTS antenna and at a distance of 10m from it. **(3)**

d. By considering the approximate power incident upon a user's head when making a call with a mobile handset, plus the previous calculations, discuss whether the health concerns of residents living close to the BTS mast are justified. **(5)**

4. **a.** Describe in detail the type of bit sequences and their duration in a *normal burst* within the GSM protocol, and which logical channels can be mapped onto it. **(10)**

b. A GSM BTS transmits in four consecutive timeslots per frame with all FSK bits set equal and with a central transmission (carrier) frequency of 900MHz. Draw a calibrated sketch of the signal spectrum showing values for

(i) The carrier frequency

(ii) The frequencies of the first two spectrum nulls

(iii) The relative height of the carrier frequency component with respect to the first spectral envelope sidelobes

(iv) The separation between spectral harmonics

explaining any Fourier techniques used in its derivation. Assume for simplicity that power ramping is instantaneous and transmission is uninterrupted during the four timeslot period. **(10)**

GGC/JZ