



FACULTY OF ENGINEERING SCIENCES
SECOND SEMESTER EXAMINATIONS: 2012/2013
LEVEL 300: BACHELOR OF SCIENCE IN ENGINEERING
CPEN 308: FUNDAMENTALS OF INFORMATION TRANSMISSION [2 Credits]

TIME: 2 HOURS

Instruction: Answer **ALL QUESTIONS** in the answer booklet provided.

1.
 - a. Draw a graph to explain the analog-to-digital (binary data) conversion process
[7 marks]
 - b. Draw a graph to explain the different components of a digital microwave transmission system.
[8 marks]
2.
 - a. Consider a mobile user who was connected to a base station in Accra Central. While talking on the phone in Accra Central, s/he run out of battery and the phone went off. Upon return to the dormitory in Legon, s/he recharged the phone and got connected to another base station in Legon. Discuss whether there was *handover* or not.
[5 marks]
 - b. Discuss three (3) advantages of optical fiber transmission over metal wire transmission.
[3 marks]
 - c. Discuss two (2) main characteristics of 4th generation optical systems, as compared to the 3rd generation.
[2 marks]
 - d. What is the difference between SONET and SDH?
[2 marks]
 - e. At which layer of the OSI model is SONET?
[1 marks]
 - f. Discuss SONET's relationship with ATM and IP.
[2 marks]
3. You need to design an information transmission system to link two towns which are 100 kms away from each other. You can choose between three different transmission media which are summarized in Table 1. No financial constraints apply.

| Medium | Transmission speed (meters/second) |
|-----------------------------|---|
| Terrestrial microwave radio | 3×10^8 |
| Coaxial cable | 2.3×10^8 |
| Optical fiber | 2×10^8 |

Table 1

- a. Which of the medium is the most prone to transmission errors? Explain. **[2 marks]**
- b. If the system is to transmit very delay-sensitive applications, which medium would be the optimal choice? Explain. **[2 marks]**
- c. Calculate the propagation delay introduced by each of the transmission media. **[6 marks]**
4. Consider an amplitude modulation (AM) radio transmission where a message signal $m(t) = A_m \cos(2\pi f_m t)$ is used to modulate a carrier signal $c(t) = A_c \sin(2\pi f_c t)$.
- a. Write the expression of the signal $s(t)$ at the output of the modulator. **[5 marks]**
- b. Find the spectrum $S(f)$ of $s(t)$. **[10 marks]**
- c. Draw $S(f)$. **[5 marks]**
5. A transmission channel has a bandwidth of 2 MHz. The signal to noise ratio (SNR) is approximately 18 dB.
- a. What is the maximum transmission bit rate over this channel in order to avoid errors? **[10 marks]**
- b. One chooses to transmit at 8 Mbps. Assuming that an M-PSK modulation (M signal levels) is used, find M and deduce the type of modulation used. **[10 marks]**
6. Consider an audio signal with frequency components limited to the frequency band 300 to 3300 Hz.
- a. What is the maximum time interval between samples of this signal if aliasing is to be avoided? Explain your answer with the help of a diagram. **[5 marks]**
- b. If this signal is to be transmitted through a baseband channel using a 12 bits/sample PCM scheme, what is the minimum required channel bandwidth? **[5 marks]**
- c. Now, assuming a passband transmission, what is the minimum required channel bandwidth using the same PCM scheme as in 6.b. above? **[5 marks]**
- d. For the channel bandwidth found in 6.b., what is the maximum bit rate which can be transmitted through this channel in order to minimize transmission error? **[5 marks]**

END OF QUESTIONS

Examiner: Koudjo M. Koumadi, Ph.D