# MACHAKOS UNIVERSITY

**University Examinations 2017/2018**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR BACHELOR OF SCIENCE IN TELECOMMUNICATION AND IT**

**SPH 104: INTRODUCTION TO TELECOMMUNICATIONS**

**DATE: 15/12/2017** **TIME: 8.30-10.30 AM**

**INSTRUCTIONS**

**ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE (COMPULSORY) (30 MARKS)**

(a) Explain the following important telecommunication tools/technologies: (5 marks)

i. Telegram
ii. Telegraph
iii. Telephone exchange
iv. Teleprinter
v. telex

(b) List and explain five types of transmission media used in telecommunication networks. (5 marks)

(c) According to Consultative Committee for International Telephone and Telegraph (CCITT), standardization of telecommunication equipment and protocols avoids many problems in the process of data communications. List four of the problems that are avoided through the standardization mechanism. (4 marks)

(d) Draw the circuit diagram of a modern communication system and describe all its constituent elements. The system should be able to process both analogue and digital signals. (12 marks)

(e) Calculate the power in one of the side band in Single-SideBand Suppressed-Carrier (SSBSC) modulation when the carrier power is 124watts and there is 80% modulation depth in the amplitude modulated signal. (2 marks)

(f) What is the carrier frequency in an amplitude modulated wave when its highest frequency component is 850Hz and the bandwidth of the signal is 50Hz? (2 marks)

**QUESTION TWO (20 MARKS)**

(a) Optical communication system can be categorized on the basis of transmission medium, wavelength and signal used to transmit the information. Based on this, describe the following optical communication systems. (6 marks)

i. free space optical communication
ii. atmospheric optical communication\
iii. optical fibre communication

(b) list and define the three different analogue modulation (2 marks)

(c) What are the requirements for a good voice communications system? (5 marks)

(d) A Phase-Locked-Loop (PLL) is used to track the time-varying carrier in a Frequency Modulation detector. Draw the circuit diagram of the PLL and describe its components briefly. (6 marks)

**QUESTION THREE (20 MARKS)**

(a) Many telecommunication services are provided to subscribers in modern telecommunication systems. Briefly explain the ones listed below. (12 marks)

i. Cellular service
ii. Videoconferencing
iii. Teleconferencing
iv. videotext

(b) Draw the basic circuit diagram of a RF transmitter and describe its components. (4 marks)

(c) Draw the circuit diagram of a AM super heterodyne receiver and describe its components/operation. (4 marks)

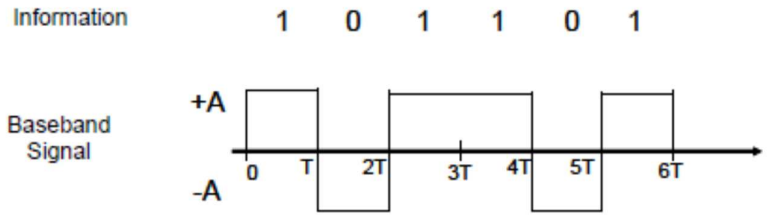
**QUESTION FOUR (20 MARKS)**

(a) Modulation of Digital Data is done using the following techniques:

- PSK- Phase shift keying
- ASK-Amplitude shift keying
- FSK- Frequency shift keying

Discuss each of these techniques under the following headings: modulation mechanism, demodulation, advantages and disadvantages, and application (s). (15 marks)

(b) Consider the following signal to be modulated and demodulated using Phase Shift Keying. Draw the modulated waveform as well the baseband signal that is discernable after smoothing at the receiver side. (5 marks)




**QUESTION FIVE (20 MARKS)**

(a) Encoding in (n,k) block code is done as shown below.

$$\mathbf{U} = \mathbf{mG}$$

$$(u_1, u_2, \ldots, u_n) = (m_1, m_2, \ldots, m_k) \cdot \begin{bmatrix} \mathbf{V}_1 \\ \mathbf{V}_2 \\ \vdots \\ \mathbf{V}_k \end{bmatrix}$$

$$(u_1, u_2, \ldots, u_n) = m_1 \cdot \mathbf{V}_1 + m_2 \cdot \mathbf{V}_2 + \ldots + m_2 \cdot \mathbf{V}_k$$

Where U is the code vector, m is the message vector and G is the generator matrix. Given the information below, determine all the possible code words.

$$\mathbf{G} = \begin{bmatrix} \mathbf{V}_1 \\ \mathbf{V}_2 \\ \mathbf{V}_3 \end{bmatrix} = \begin{bmatrix} 1\,1\,0\,1\,0\,0 \\ 0\,1\,1\,0\,1\,0 \\ 1\,0\,1\,0\,0\,1 \end{bmatrix}$$

| Message vector |
|---|
| 000 |
| 100 |
| 010 |
| 110 |
| 001 |
| 101 |
| 011 |
| 111 |

(10 marks)

(b) For any positive integer *r*, there exists a binary Hamming code with

$$(n,k) = (2^r - 1, 2^r - 1 - r)$$

This kind of codes have a minimum distance $d_{min} = 3$ and can be characterized with a parity check matrix **H** which has all the possible bit vectors of length *r* (except the all-zero vector). Show that the Hamming codes are perfect codes. (10 marks)