UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
MAIN EXAMINATION 2011

TITLE OF PAPER	:	DIGITAL COMMUNICATIONS
COURSE NUMBER	:	E530
TIME ALLOWED	:	THREE HOURS
INSTRUCTIONS	:	READ EACH CAREFULLY ANSWER ANY **FOUR** QUESTIONS. EACH QUESTION CARRIES **25 MARKS** MARKS FOR EACH SECTION ARE SHOWN ON THE RIGHT-HAND MARGIN

THIS PAPER HAS SIX PAGES INCLUDING THIS PAGE.

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

QUESTION No. 1

(a) With aid of a neat block diagram explain the PCM transmission system and sketch its input, output and sample wave forms.

[10 marks]

(b) A PCM system with the following parameters,

Maximum analog i/p frequency = 4 kHz
Maximum decoded voltage at the receiver = +/- 2.55v
Maximum dynamic range = 46 dB

Determine:

- Minimum sample rate
- Minimum number of bits used in the PCM code
- Resolution and
- Quantization error

[12 marks]

(c) What is meant by coding efficiency? [3 marks]

QUESTION No. 2

(a) Explain the Delta modulation transmitter with an ideal operation of a delta modulation encoder. [9 marks]

(b)What is companding? [2 marks]

(c) Explain the output frequency shift in response to input signal logic in FSK system. Sketch the output spectrum corresponding to input logic. [10 marks]

(d) Determine the peak frequency deviation and minimum bandwidth for a binary FSK signal with a mark frequency of 49KHz, a space frequency of 51KHz and an input bit rate of 20Kbps. [4 marks]

QUESTION No. 3

(a) Explain the operation of a QPSK transmitter with neat block diagram and construct the truth table, phasor diagram and constellation diagram. Draw the output phase-versus time relationship for a QPSK modulator.

[13 marks]

(b) For a QPSK modulator with an input data rate (f_b) equal to 10Mbps and a carrier frequency of 70 MHz, determine the minimum double sized Nyquist bandwidth (f_N) and symbol rate. Sketch the output spectrum.

[8 marks]

(c) Explain the relationship between the input data, the XNOR output data and the phase at the output of the balanced modulator in DBPSK transmitter.

[4 marks]

QUESTION No. 4

(a) Explain the optimum Filter realization using Matched filter and draw the wave forms for the input signals S_1 (t), S_2 (t), and impulse response of the matched filter P(t) and P(-t), P(T-t) .

[9 marks]

(b) Derive the equation for Probability of error of the Matched filter.

[8 marks]

(c) For an equiprobable binary base band data the optimal receiver receives -5mv for 0 and +5mv for 1, corrupted with white noise of PSD 10^{-9} W/Hz. With optimum decision threshold what is the probability of error in reception if data rate is 9600 bits/sec? Find the percentage increase in error rate if data rate is doubled.

[8 marks]

QUESTION No. 5

(a) What is Entropy? Explain how the probabilities of messages depend on average information. [7 marks]

(b) Define Information rate. [2 marks]

(c) An analog signal is band limited to B Hz. Sampled at the Nyquist rate and the samples are quantized into 4 levels. The quantization levels Q_1, Q_2, Q_3 and Q_4 (messages) are assumed independent and occur with probabilities $P_1=P_4=1/8$ and $P_2=P_3=3/8$. Find the information rate of the source.

[4 marks]

(d) Five source messages occur with probabilities $m_1=0.4$, $m_2=0.15$, $m_3=0.15$, $m_4=0.15$, $m_5=0.15$. Find the coding efficiency for (a) Shanon-Fano coding (b) Huffman coding.

[12 marks]