NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

BACHELOR OF ENGINEERING (HONS) DEGREE

Examination January 2013

TEE 5121 Communication Systems Performance

Duration of Examination 3 Hours

Instructions to Candidates:

1. Answer any **five** questions only.
2. Each question carries equal marks.
3. Show all your steps clearly in any calculation.
4. Start the answers for each question on a fresh page.

Question 1

(a) Derive the expression of bit error rate (BER) for a Polar signalling baseband signal. Show the representation of the receiver and waveform .State the conditions which are applied for the expression. (12 marks)

(b) Illustrate the recovery of quadrature components x(t) and y(t) from the composite signal v(t) using a product detector. (8 marks)

Question 2

(a) Explain the integrate-and-dump filter .Show the associated signalling pulses with the correct times . (10marks)

(b) With the help of block diagram and waveforms show the integrate –and –dump realization of a matched filter. (10 marks)

Question 3

(a) What is a Gaussian random variable? When are two Gaussian random variables joint? (8 marks)

(b) Show and describe the matched filter receiver with coloured Gaussian noise Give the reasons that might cause any signal degradation . (12 marks)

Question 4

(a) The input of a high gain RF amplifier has an equivalent resistance value of 1kΩ.The amplifier has an overall voltage gain of 1000 and a bandwidth of 200 kHz .Estimate the maximum noise amplitude at the input to the amplifier due to the thermal noise only when operating a temperature of 29° C. What does the calculated value mean in terms of useful received signal ? (7 marks)

(b) A satellite in geosynchronous orbit (36000 Km) radiates 100 W of power .The transmitting antenna has a gain of **18 dB ,so that** EIRP is 38 dBW .The earth station employs a 3m parabolic antenna and the downlink is transmitting at 4GHz. Determine the received

Power (13 marks)

Question 5

(a) Explain how thermal noise sources are produced in a receiver. Derive the basis of the value of noise voltage. Show how it is modelled give the justification of the expression.

(10 marks)

(b) Give the classification of noise in communication systems. Give examples of noise found .Give some other ways used to reduce the noise. (4 marks)

(c) The 22 GHz,60GHz and 120GHz frequency band should be avoided as transmission bands .Explain why each of the bands should be avoided. (6 marks)

Question 6

(a) Describe the coherent detection of Frequency shift keying .Show the receiver arrangement the conditions of bit error rate ,and derive the expression for bit error for the type of signalling . (14) marks).

(c) Describe the three synchronisation levels that are used . (6 marks)

Question 7

(a) A communication receiving system has an antenna with T_A=100K two amplifiers with T_e =200K and a gain of 60 dB and 50 dB with a noise figure of F=6 dB.

(i) Calculate the effective noise temperature of the system.

(ii) Calculate the noise figure at the output if the noise figure for the amplifier is 2.28 dB and 6 dB.

(iii) Calculate the noise power at the output. (15 marks)

(b) List five properties of the power spectral density . (5 marks)

Question 8

(a) State the properties of a real valued autocorrelation function . (3 marks)

(b) Show the relevant moments of the ergodic process that corresponds to DC value ,rms value , average value of power and variance. (8 marks) .

(c) Describe and show the arrangement of a quadrature phase shift keying. (9 marks)