Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 2, 2017					

ENG473 – Communication Systems	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes

INSTRUCTIONS TO CANDIDATES

EXAM CONDITIONS
<u>You may begin writing from the commencement of the examination session.</u> The reading time indicated above is provided as a guide only.
This is a RESTRICTED OPEN BOOK examination
Any non-programmable calculator is permitted
No handwritten notes are permitted
No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
Lecture Textbook/s (Unannotated)	1 x 20 Page Book 1 x Scrap Paper

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 (5 marks)

How many bits are required for an analogue to digital converter (ADC) to encode music where the dynamic range is 120 dB? Assume that the maximum voltage is 1 Volt.

Question 2 (10 marks)

A binary data system is to be designed for r_b=6 Mb/sec and $P_{be} \leq 10^{-7}$. The $M=2^n$ level signals having the Nyquist pulse shaping are encoded by Gray coding. The noise is White Gaussian with N_0=10 pW/Hz (pico W/Hz). The transmission channel has loss=50 dB and is distortionless over the allocated bandwidth B=800 KHz. Answer the following questions:

a) Determine the value of M to minimise the transmitted power (2.5 marks)
b) Based on the result obtained from part (a), determine values of signalling rate (r), roll-off factor (β) and the transmitted signal power (S_T) (7.5 marks)

Question 3 (20 marks)

The waveforms of a binary OOK signal are as follows:

$$S_1(t)=\begin{cases} \frac{3}{2T_b}t & 0 \leq t < \frac{T_b}{3} \\ \frac{1}{T_b}(T_b - t) & \frac{T_b}{3} \leq t < T_b \end{cases}$$ for transmission of 1

$S_0(t)=0$ for transmission of 0

Let T_b=10 μsec, $N_0=10^{-6}$ (W/Hz). Probability of transmission 0s and 1s are: p(0 sent)=1/3 and p(1 sent)=2/3. Determine the average probability of error (P_e).

Question 4 (15 marks)

Figure 1 shows a coherent detector for detecting the following two equally probable signals:

$S_1(t) = \sqrt{\frac{2E}{9T_b}}\cos(\omega_0 t)$ $S_2(t) = \sqrt{\frac{5E}{3T_b}}\cos(\omega_0 t + \frac{\pi}{6})$, where $\omega_0 = \frac{2\pi}{T_b}$.

Determine the threshold decision level (The value of V shown in the figure) for an AWGN channel. Power spectral density of the noise is $N_0/2$. Consider

$\Phi(t) = \sqrt{\frac{2}{T_b}}\cos(\omega_0 t)$.

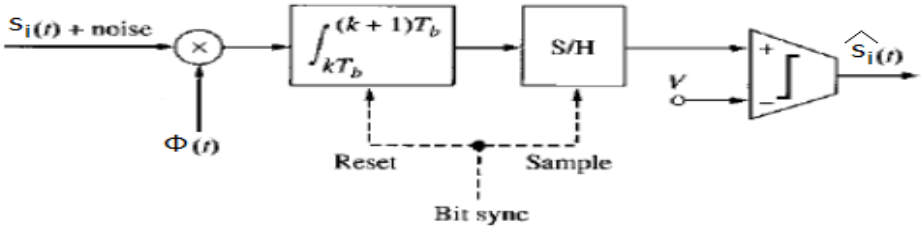

Figure 1.

Question 5 (15 marks)

Let the P submatrix for (21,16) linear block code be arranged such that the row words increase in numerical value from bottom to top. Answer the following questions:

a) Construct the look up table.
b) Write the check-bit equations.
c) What is the minimum distance of this code?

Note: Numerical numbers includes the numbers that are not in order of 2.

Question 6 (15 marks)

A selective–repeat ARQ system with Gaussian white noise is to have $P_{be}=10^{-5}$ using (12,11) code with $d_{min}=2$ for error detection. Answer the following questions:

a) Determine r_b/r.
b) Determine γ_b for the given code and un-coded transmission.