程序代写代做 CS编程辅导

Durham University

Examination Paper

Examination Session:	Year:	Exam Code:
May/June	2021	ENGI4507-WE01

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Title:		
MEng: Radio and Digital Communications 4		
Time Allowed:	2 hours	
Additional Material provided:	No	
Materials Permitted:		
Calculators Permitted:	Yes	Models Permitted: Those from the Casio fx-83 and fx-85 series.
Visiting Students may use dictionaries: Yes		

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Instructions to Candidates:	Answer ALL questions. All relevant workings must be shown.

Revision:	

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Question 1

(a) A frequency shift k unication system transmits $s_o(t)$ to represent binary 1 (mark) and $s_1(t)$ to (space), where

$s_o($ $0 < t < T$

$s_1($ $0 < t < T$

Assuming that $T \gg 1/f_o$ and $T \gg 1/f_1$

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(i) Find the energy per bit.

[15%]

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(ii) Find an expression for the correlation coefficient ρ between the mark and space signals.

[20%]

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(iii) Deduce the relationship that gives zero correlation coefficient.

[10%]

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(b) Assume binary coded information is transmitted at 10 kb/s using FSK signal. The received amplitude of each tone is 2×10^{-2} V. The additive single sided noise power density spectrum is 10×10^{-9} W/Hz. Find the bit error rate of a coherent detector using the table of the complementary error function for correlation coefficients of (i) 0 and (ii) 0.3 and comment on the result.

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[25%]

Use can be made of the following relationships:

$$P_e = \frac{1}{2} erfc\sqrt{\frac{E(1-\rho)}{2N_o}} \quad \text{and} \quad \rho = \frac{\int_0^T s_{mark}(t)s_{space}(t)dt}{\sqrt{\int_0^T s(t)^2_{mark}dt \int_0^T s(t)^2_{space}dt}}$$

where P_e is the probability of error, E is the energy per bit and ρ is the correlation coefficient, $s_{mark}(t), s_{space}(t)$ are the mark and space signals, respectively and T is the bit duration.

$$\cos(2\pi f_1 t).\cos(2\pi f_2 t) = \frac{1}{2}\{\cos(2\pi f_1 + 2\pi f_2)\,t + \cos(2\pi f_1 - 2\pi f_2)\,t\}$$

(c) A time division multiplexing pulse analogue modulated system transmits eight audio telephony signals with baseband bandwidth equal to 3.4 kHz and two music signals with baseband bandwidth equal to 15 kHz. For an 8-bit analogue to digital converter determine the required bandwidth of transmission for

(i) Unipolar non return to zero (NRZ).

continued

(ii) Unipolar return to zero (RZ).

(iii) Manchester code.

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[30%]

Question 2

(a) A mobile user is tr[illegible] of 50 km/hr as shown in Figure Q.2.1.a-b. Assume that the mobile phone [illegible] to noise ratio of 18 dB and that the noise floor of the receiver is -100 d[illegible] both base stations transmit 20 dBm and use antennas with 3 dB gain, w[illegible]ses an antenna with 0 dB gain and that the foliage attenuation is 10 d[illegible]ons have dual frequency bands at 900 MHz and 1800 MHz.

(i) Find the antenna gains in linear scale.

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[10%]

(ii) Find the transmit power in mW for the base station.

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[10%]

(iii) Given the relationship in equation 2.1 for free space path loss, determine the time at which the mobile phone would need to be handed over from base station 1 BS1 to base station 2 BS2 for 900 MHz and 1800 MHz operating frequencies for Figures Q2.1.a and Q.2.1.b for a 2 dB margin for hand off.

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$$\frac{P_R}{P_T} = G_T G_R \left[\frac{c}{4\pi f d}\right]^2 \qquad (2.1)$$

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where P_T and P_R are the transmit and receive powers respectively, G_T and G_R are the gains of the transmit and receive antennas respectively, *d* is the distance from the transmitter and *f* is the transmission frequency.

[35%]

(iv) Comment on the success of the handover strategy for both scenarios at the two frequencies.

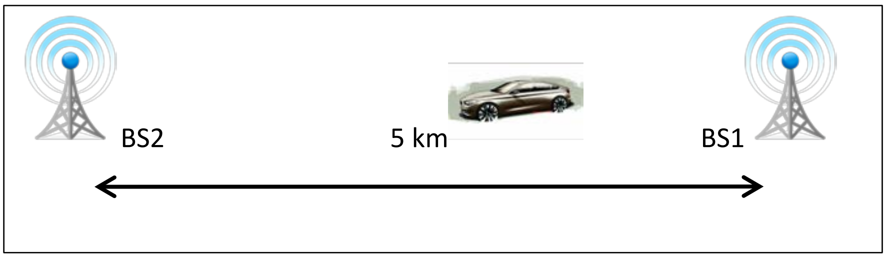

Figure Q.2.1.a

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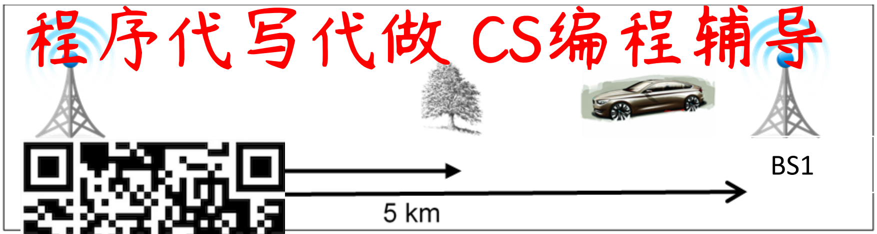

Figure Q.2.1.b

[20%]

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(b) A cellular system has 15 channels to be multiplexed. Each user has a data rate of 10 kbps. Determine the overall bandwidth required for the system using frequency division multiple access.

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[10%]

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(c) Discuss the different mechanisms of propagation that connect the transmitter and a receiver.

[15%]

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Error function and the complementary error function

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$$\mathrm{erf}(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-u^2}\ du\ , \mathrm{erfc}(x) = \frac{2}{\sqrt{\pi}}\int_x^\infty e^{-u^2}$$

Table of Error function and co[illegible]ction

x	erf(x)	[illegible]	x	erf(x)	erfc(x)
0.00	0.0000000	[illegible]	[illegible]30	0.9340079	0.0659921
0.05	0.0563720	[illegible]	[illegible]40	0.9522851	0.0477149
0.10	0.1124629	0.8875371	1.50	0.9661051	0.0338949
0.15	0.1679960	0.8320040	1.60	0.9763484	0.0236516
0.20	0.2227026	0.7772974	1.70	0.9837905	0.0162095
0.25	0.2763264	0.7236736	1.80	0.9890905	0.0109095
0.30	0.3286268	0.6713732	1.90	0.9927904	0.0072096
0.35	0.3793821	0.6206179	2.00	0.9953223	0.0046777
0.40	0.4283924	0.5716076	2.10	0.9970205	0.0029795
0.45	0.4754817	0.5245183	2.20	0.9981372	0.0018628
0.50	0.5204999	0.4795001	2.30	0.9988568	0.0011432
0.55	0.5633234	0.4366766	2.40	0.9993115	0.0006885
0.60	0.6038561	0.3961439	2.50	0.9995930	0.0004070
0.65	0.6420293	0.3579707	2.60	0.9997640	0.0002360
0.70	0.6778012	0.3221988	2.70	0.9998657	0.0001343
0.75	0.7111556	0.2888444	2.80	0.9999250	0.0000750
0.80	0.7421010	0.2578990	2.90	0.9999589	0.0000411
0.85	0.7706681	0.2293319	3.00	0.9999779	0.0000221
0.90	0.7969082	0.2030918	3.10	0.9999884	0.0000116
0.95	0.8208908	0.1791092	3.20	0.9999940	0.0000060
1.00	0.8427008	0.1572992	3.30	0.9999969	0.0000031
1.10	0.8802051	0.1197949	3.40	0.9999985	0.0000015
1.20	0.9103140	0.0896860	3.50	0.9999993	0.0000007

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