SINGAPORE POLYTECHNIC **ET0930**

SAMPLE SEMESTER EXAMINATION **Paper 2**

Diploma in Electrical & Electronic Engineering (DEEE)
3rd Year FT

Instructions to Candidates:

1. The Singapore Polytechnic examination rules are to be complied with.

2. This paper consists of **TWO** sections:
   Section A: 5 short questions, 12 marks each
   Section B: 2 Long Questions, 20 marks each

3. **ALL** questions are **COMPULSORY**.

4. All questions are to be answered in the answer booklet.
   Start each question on a new page.

5. Fill in the Question Number, in the order that it was answered, in the boxes found on the front cover of the answer booklet under the column "Question Answered".

6. This paper consists of **10** pages, including 2 pages of Formula List and 4 pages of Complementary Error Function Table.

7. The question paper must be submitted together with the answer booklet at the end of this exam session.

SECTION A (5 Short Questions, 60 marks)

A1. A 12 V_{peak}, 95 MHz carrier is frequency modulated by a 2 V_{peak}, 20 kHz single-tone signal. The conversion gain of the FM modulator is 20 kHz/V.

(a) Determine the frequency range of the FM signal. (4 marks)

(b) Determine whether it is WBFM or NBFM. (4 marks)

(c) Using Carson's rule, find the bandwidth of the FM signal. (2 marks)

(d) Determine the FM power when the FM signal is applied to a 50 Ω load. (2 marks)

A2. The bandlimited signal f(t) is ideally sampled at 200 samples per second as shown in FigureA2, where f(t) = 100sinc 100t.

(a) Sketch the amplitude spectrum of f(t). (4 mark)

(b) Sketch the amplitude spectrum of the sampled signal $f_p(t)$ over -300Hz < f < 300Hz. (8 mark)

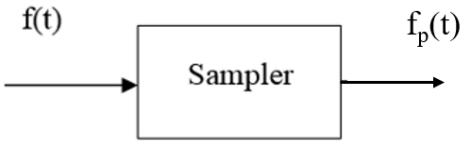

Figure A2

A3. The input-output characteristic of a mid-riser quantizer is shown in Figure A3.

(a) Determine the step size and the maximum quantization error. (4 marks)

(b) Determine the quantized output voltage and the quantization error when an input of -1.5V DC signal is applied to the quantizer. (4 marks)

(c) State two ways to improve the output signal-to-quantization noise ratio. (4 marks)

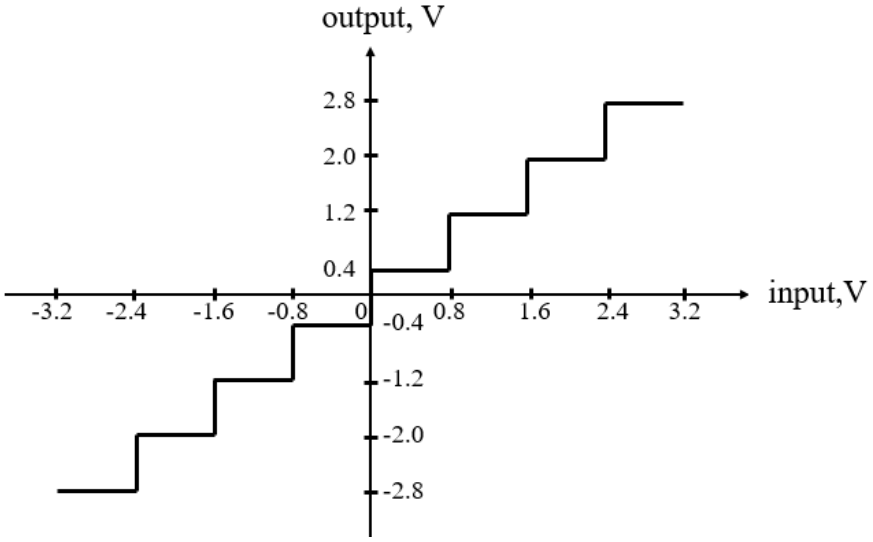

Figure A3

A4. A baseband digital communication system transmits random equiprobable binary signals. The transmission channel is affected by additive white Gaussian noise (AWGN) of rms value of 0.6 mV. The signal component received at the receiver is of the waveform shown in Figure A4. The receiver contains a simple comparator.

(a) State four characteristics of thermal noise. (4 marks)

(b) Determine the threshold voltage of the comparator at the receiver to achieve minimum probability of bit error. (2 marks)

(c) Calculate the probability of bit error, P_e. (4 marks)

(d) Determine the number of error bits received on average when 2 million bits are transmitted. (2 marks)

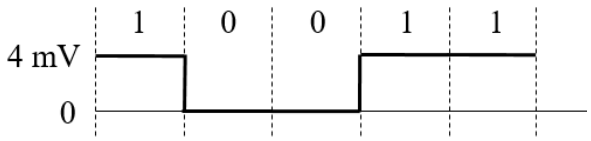

Figure A4

A5. A baseband digital communication system transmits logic '1' as $s_2(t)$ and logic '0' as $s_1(t)$ as shown in Figure A5.1. The system uses an Integrate-and-Dump Correlation receiver shown in Figure A5.2.

(a) Sketch the waveform at A, B and C for a sequence of 1100. (6 marks)

(b) Assume that the input signal to the receiver has an amplitude of 12 mV with a bit rate of of 9000 bits/sec and that the binary bits of the input signal are independent and equiprobable. Calculate the probability of bit error if the single-sided power spectral density of the AWGN channel is 2×10^{-9} watt/Hz. (6 marks)

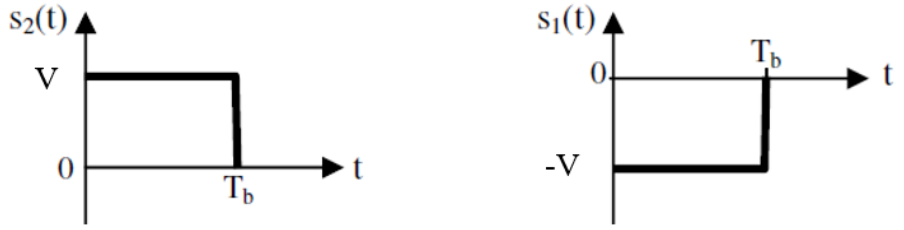

Figure A5.1

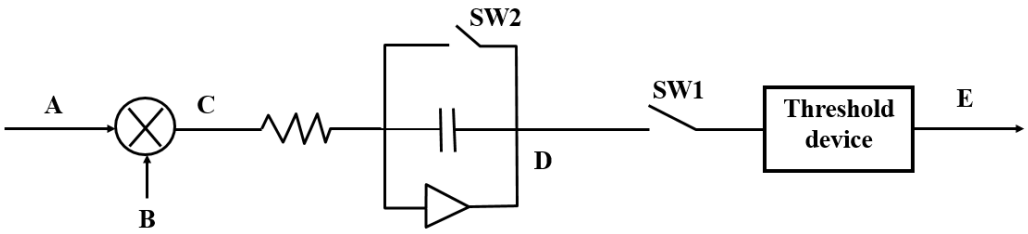

Figure A5.2

SECTION B (2 Long Questions, 40 marks)

B1. One voice signal, one music signal and a data signal are transmitted by a PCM-TDM system in which 8-bit uniform quantisers is employed. The voice signal is bandlimited to 4 kHz and the music signal is bandlimited to 10 kHz while the data signal is bandlimited to 9 kHz. The system requires synchronisation information.

(a) Sketch the PCM-TDM commutator system capable of handling these four signals. Ensure that uniform sampling is achieved. (10 marks)

(b) Determine the commutator speed. (2 marks)

(c) Calculate the gross output bit rate. (5 marks)

(d) Determine the minimum transmission bandwidth required if NRZ format is used. (3 marks)

B2. A BPSK system is used to transmit binary data through a passband channel. Figure B2 shows a portion of the BPSK carrier at the receiver. The double-sided power spectral density of the AWGN in the channel is 2×10^{-9} watt/Hz.

(a) Describe briefly what is Phase Shift Keying (PSK) modulation. (4 marks)

(b) List one advantage and one disadvantage of BPSK over DPSK. (4 marks)

(c) Determine the bit rate, r_b and the carrier frequency. (6 marks)

(d) If an Integrate-and-Dump Correlation receiver is used, find the probability of bit error. (6 marks)

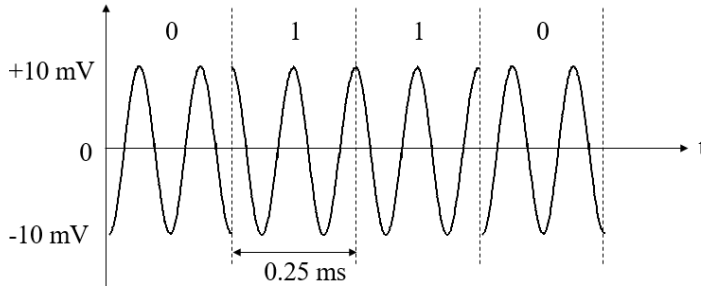

Figure B2

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