ECE 241 **Homework No. 1** **Spring 2007**
Gibson

Due Wednesday, April 11, in class.

9.18 Calculate the SQNR for a full-load sinusoid in segment 1 of the characteristic in Table 9.6.1. Assume that the quantization noise is uniformly distributed.

9.19 For a full-load sinusoid for the characteristic in Table 9.6.1 (a peak value of 8159), calculate the fraction of time that the amplitude of this sinusoid falls within each segment in the table.

9.20 An approximate value of the SQNR of the characteristic in Table 9.6.1 can be obtained from Eq. (9.2.3) with

$$D = \sum_{i=1}^{8} p_i \frac{\Delta_i^2}{12},$$

where p_i is the probability of the input amplitude falling within segment i and Δ_i is the step size for the ith segment. Use the results of Problem 9.19 to calculate SQNR for the characteristic in Table 9.6.1 with a full-load sinusoid input [Bellamy, 1982].

9.21 Using the SQNR values and input amplitudes from Problems 9.18 and 9.20, show that the coder maintains an SQNR of greater than 30 dB for a range of input powers of 48.4 dB. This quantity is called the coder *dynamic range*. Note that this value is approximately the same as

$$20 \log_{10} \frac{\Delta_{\max}}{\Delta_{\min}} = 20 \log_{10} (1 + \mu).$$

TABLE 9.6.1 Quantizer Characteristic and Code Assignment for D2, D3, and D4 Channel Bank Codecs[a]

Input Amplitude Range:	Step Size:	Polarity Bit:	Quantization Segment Code:	Quantizer Step Code:	Output Value:
0–1	1	1	111	1111	0
1–3 3–5 ⋮ 29–31	2	1	111	1110 1101 ⋮ 0000	2 4 ⋮ 30
31–35 ⋮ 91–95	4	1	110	1111 ⋮ 0000	33 ⋮ 93
95–103 ⋮ 215–223	8	1	101	1111 ⋮ 0000	99 ⋮ 219
223–239 ⋮ 463–479	16	1	100	1111 ⋮ 0000	231 ⋮ 471
479–511 ⋮ 959–991	32	1	011	1111 ⋮ 0000	495 ⋮ 975
991–1055 ⋮ 1951–2015	64	1	010	1111 ⋮ 0000	1023 ⋮ 1983
2015–2143 ⋮ 3935–4063	128	1	001	1111 ⋮ 0000	2079 ⋮ 3999
4063–4319 ⋮ 7903–8159	256	1	000	1111 ⋮ 0000	4191 ⋮ 8031

[a] Positive inputs only; assumed symmetric about zero.