NANYANG TECHNOLOGICAL UNIVERSITY
School of Electrical & Electronic Engineering

EE/IM4152 Digital Communications

Tutorial No. 3 (Sem 1, AY2016-2017)

1. Consider the following line coding scheme. A ‘0’ is transmitted by no pulse and a ‘1’ is transmitted by a pulse $p(t)$ or $-p(t)$ using the following rule. If a ‘1’ is preceded by ‘1’, then it is encoded by the same pulse as that used for the preceding ‘1’. If a ‘1’ is preceded by a ‘0’, then it is encoded by a pulse negative of the pulse used to encode the ‘1’ that occurred before the present ‘1’. Determine only up to coefficient R_3.

2. Duobinary signalling was proposed by Adam Lender in 1963. In this signalling scheme, a ‘0’ is transmitted by no pulse, and a ‘1’ is transmitted by a pulse $p(t)$ or $-p(t)$, depending on the polarity of the previous pulse and the number of 0’s between them. In particular, a ‘1’ is encoded by the same previous pulse if there is an even number of ‘0’s between them. Otherwise, it is encoded by the negative of the pulse used to encode the previous ‘1’.

   (a) Use a diagram to show the coding process of the sequence 110010001100…, where the first bit ‘1’ is assumed to be encoded by $p(t) = \mathrm{rect}\left(\frac{t - T_b/2}{T_b}\right)$, where T_b is the bit duration.

   (b) Derive the power spectral density (PSD) of the duobinary signal. The pulse $p(t)$ has been defined in part (a).

3. (a) A random binary data sequence 100110... is transmitted using a Manchester (split-phase) line code with the basic pulse shown in Figure 1, where T_b is the bit duration. Sketch the waveform $y(t)$.

   (b) Derive the power spectral density function $S_y(f)$ of $y(t)$ in part (a). Note that the transmitted data ‘1’ and ‘0’ are assumed to be equally likely. Find the bandwidth of $S_y(f)$.

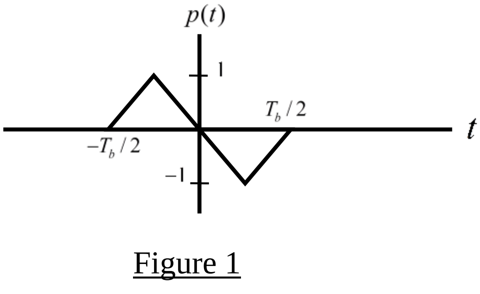

Figure 1