

***KFUPM - COMPUTER ENGINEERING DEPARTMENT*****COE-341 – Data and Computer Communication****Assignment # 3 – Due date: Monday April 23<sup>th</sup>, 2012****Student Name:****Student Number:**

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<b>Problem #</b>	<b>Maximum Mark</b>	<b>Mark</b>
<b>1</b>	<b>10</b>	
<b>2</b>	<b>20</b>	
<b>3</b>	<b>20</b>	
<b>4</b>	<b>10</b>	
<b>Total</b>	<b>60</b>	

**Problem 1: (10 points)** For the shown waveform, determined the beginning and end of bit periods (i.e. extract the clock information) and give the actual data sequence encoded by the waveform. Assume the waveform belongs to a Manchester encoded binary data stream.



**Problem 2: (20 points)** What SNR ratio is required to achieve a bandwidth efficiency of 1.0 for ASK, FSK, PSK, and QPSK? Assume that the required bit error rate is  $10^{-6}$ .

Hint: use Figure 5.4 of textbook page 147. Approach similar to example laid out in slides 55 and 56.

**Problem 3: (20 points)** A sine wave is to be used for two different signaling schemes: (a) PSK; (b) QPSK. The duration of the signal element is  $10^{-5}$  seconds. If the received signal is of the following form:  $s(t) = 0.005 \sin(2\pi 10^6 t + \theta)$  volts. If the measured noise power at the receiver is  $2.5 \times 10^{-8}$  Watts, determine the  $E_b/N_0$  (in dB) for each signaling scheme. Assume the filtering parameter  $r$  is equal to 0.

**Problem 4: (10 points)** The bipolar-AMI waveform representing the binary sequence 0100101011 is transmitted over a noisy channel. The received waveform shown in Figure below contains a single error. Locate the position of this error and explain your answer.

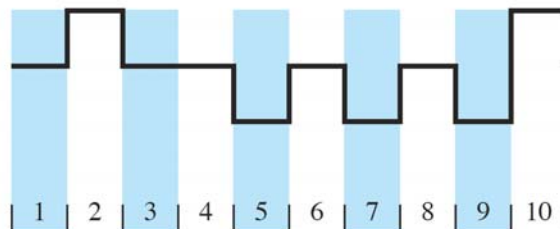


Figure: A received bipolar-AMI waveform.