

國立高雄應用科技大學
九十七學年度碩士班招生考試
電機工程系（丙組）

准考證號碼 （考生必須填寫）

通訊系統

試題 共 2 頁，第 1 頁

注意：a. 本試題共 5 題，共 100 分。

b. 作答時不必抄題。

c. 考生作答前請詳閱答案卷之考生注意事項。

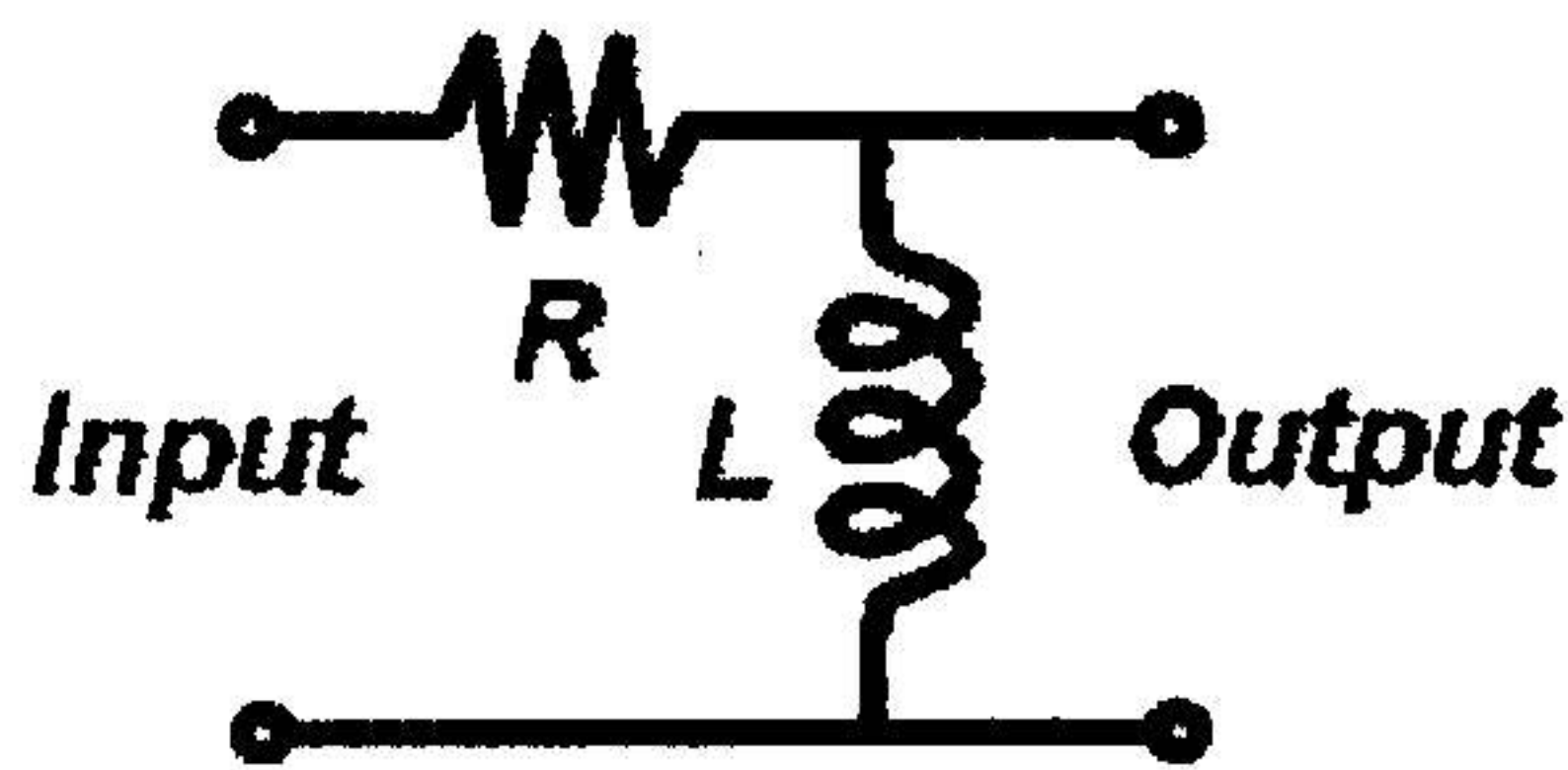
- I. Please calculate the variance and the covariance based on the given conditions as the means of $E[X]=2$ and $E[Y]=3$, the variances of $\text{Var}[X]=5$ and $\text{Var}[Y]=7$, and $Z=X+2Y$ if the X and Y are statistically independent.

(a) $\text{Var}[2X+3Y]$ (5%).

(b) $\text{Cov}[XY]$ (5%).

(c) $\text{Cov}[XZ]$ (5%).

- II. Consider a white Gaussian noise process of zero mean and power spectral density $N_0/2$ that is applied to the input of high pass RL filter as below



$$\text{Note: } e^{-a|t|} = \int_{-\infty}^{\infty} \frac{2a}{a^2 + (2\pi f)^2} e^{j2\pi f t} df$$

Please answer the following questions.

(a) What is the power spectral density of the filter output (5%)?

(b) What is the auto-correlation function of the filter output (5%)?

(c) What is the mean of the filter output (5%)?

(d) What is the variance of the filter output (5%)?

- III. There is a popular method to obtain a practical synchronous receiver system, suitable for demodulating the DSB-SC waves, so-called Costas

receiver. Please plot out the block diagram of the receiver that consists of two coherent detectors supplied with the same input signal, but with the individual local oscillator signals that are in phase quadrature with respect to each other. (15%)

- IV. In order to investigate the spectrum of FM signal varied in the amplitude and frequency of a sinusoidal modulating signal, we have known the discrete spectrum of a FM signal is expressed by

$$S(f) = \frac{A_c}{2} \sum_{n=-\infty}^{\infty} J_n(\beta) [\delta(f - f_c - nf_m) + \delta(f + f_c + nf_m)].$$

Where A_c is the carrier amplitude,

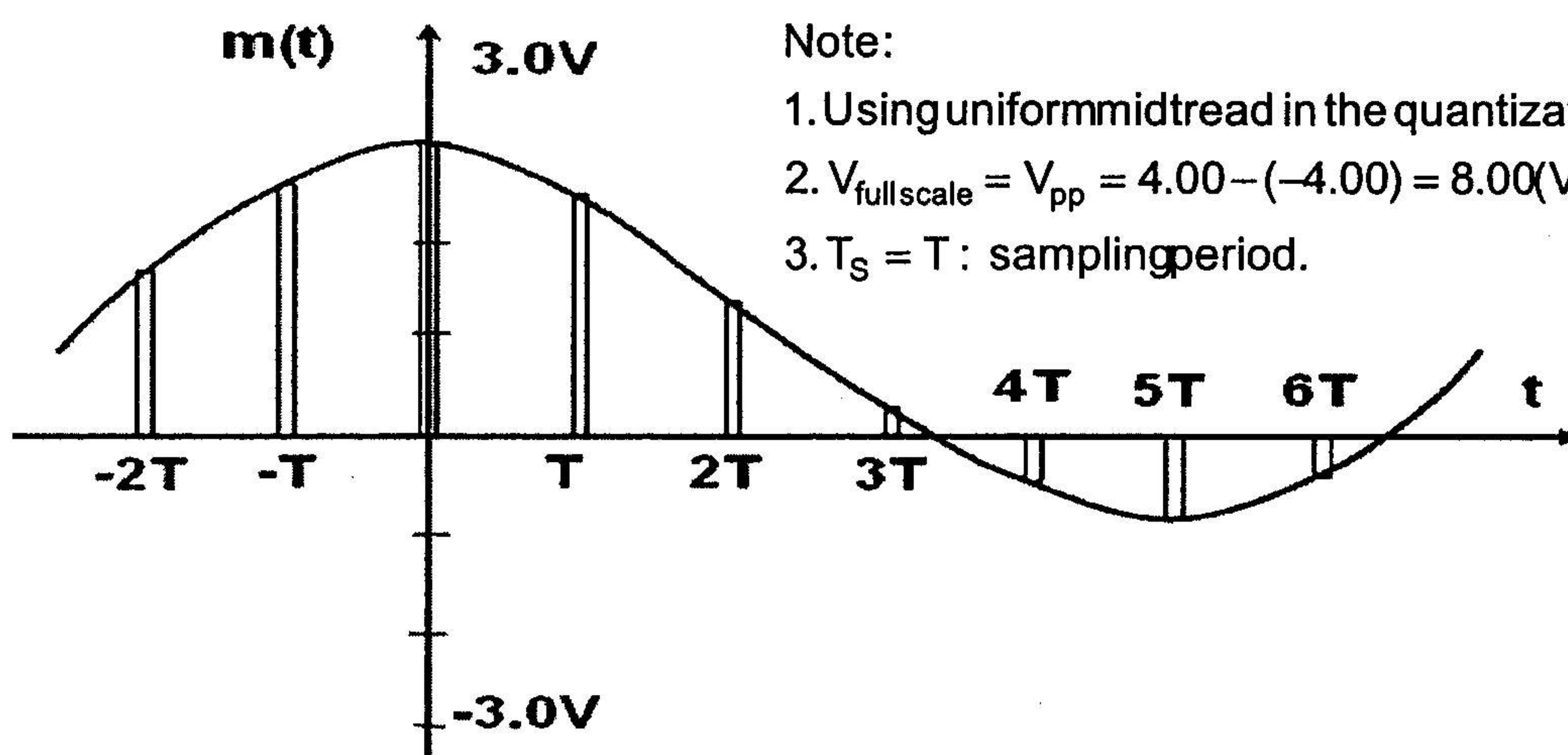
$\beta = \Delta f / f_m$ is the ratio of frequency deviation Δf to the modulation frequency f_m , f_c is the carrier frequency, and J_n is the n^{th} order Bessel function of the first kind.

Please plot out the discrete amplitude spectra of an FM signal for (a) $\beta=1$ for the case if sinusoidal modulation of varying amplitude and fixed frequency (10%).

(b) $\beta=1$ for the case if sinusoidal modulation of varying frequency and fixed amplitude (10%).

Note: the number of significant side frequencies equals to 6 if $\beta=1$.

- V. Based on the following graph, please use the sampling theorem to define the binary code and answer the following questions accordingly.



$V_n(V)$ 1.82 2.65 2.96 2.68 1.42 0.46 -0.51 -0.95 -0.44

- (a) What is the quantization error if using 4 bits scheme (10%)?
 (b) What is the quantization error if using 5 bits scheme (10%)?
 (c) What changes will be in (a) if changing the $T_s=T$ to $T_s=2T$ (10%)?

===== End of this test paper. =====