No. of Printed Pages : 7

MINI-004

M.Tech. IN ADVANCED INFORMATION TECHNOLOGY – INTELLIGENT SYSTEMS AND ROBOTICS (MTECHSR)

0214

Term-End Examination

December, 2014

MINI-004 : COMMUNICATION SYSTEMS ENGINEERING

Time : 3 hours *Maximum Marks : 100*

Note :

(i) *Section I is* ***compulsory****.*

(ii) *In section II, answer any* ***five*** *questions.*

(iii) *Assume suitable data wherever required.*

(iv) *Draw suitable sketches wherever required.*

(v) *Italicized figures to the right indicate maximum marks.*

SECTION I

1. The message signal in a DSB-AM system is of the form $m(t) = 12 \cos(6\pi t) + 3 \cos(10\pi t)$:

(a) Calculate the message power, P_m. *3*

(b) If this message is DSB-AM modulated on a carrier with amplitude A_c, calculate the Fourier series of $x_z(t)$. *3*

(c) Assuming $f_c = 20$ Hz, calculate the Fourier series of $x_c(t)$ and plot the resulting time waveform when $A_c = 1$. *3*

(d) Compute the output power of the modulated signal, P_{xc}. 3

(e) Calculate and plot $x_p(t)$. 3

2. Suppose you need to locate the object in a three dimensional space using a navigation system.

(a) Which type of navigation method will you prefer ? Justify. 6

(b) Explain how you will track the object using mathematical model. 9

SECTION II

3. In natural sampling, an analog signal g(t) is multiplied by a periodic train of rectangular pulses c(t). Given that the pulse repetition frequency of this periodic train is f_s and the duration of each rectangular pulse is T (with $f_sT<<1$) do the following :

(a) Find the spectrum of the signal s(t) that results from the use of natural sampling; you may assume that time t = 0 corresponds to the midpoint of a rectangular pulse in c(t). 7

(b) Show that the original signal m(t) may be recovered exactly from its naturally sampled version, provided that the conditions embodied in the sampling theorem are satisfied. 7

4. (a) In the DPCM system depicted below in Figure 1, show that in the absence of channel noise, the transmitting and receiving prediction filters operate on slightly different input signals. 7

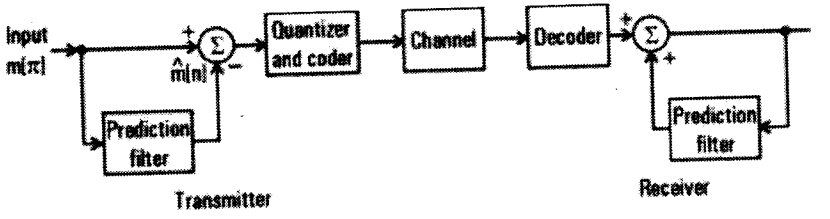

Figure 1

(b) A fast FH/MFSK system number of bits per MFSK symbol = 4, number of MFSK symbols per hop = 5. Calculate the processing gain of the system. 7

5. (a) Suppose that non-linear devices are available for which the output current i_o, and the input voltage v_i are related by $i_0 = a_1 v_i + a_3 v_i^3$. Explain how these devices may be used to provide as a product modulator and an amplitude modulator. 7

(b) A DSB-SC modulated signal is transmitted over a noisy channel, with the power spectral density of the noise being shown in Figure 2. The message bandwidth is 4 kHz and carrier frequency is 200 kHz. Assuming that the average power of the modulated wave is 10 Watts, determine output signal to noise ratio of the receiver. 7

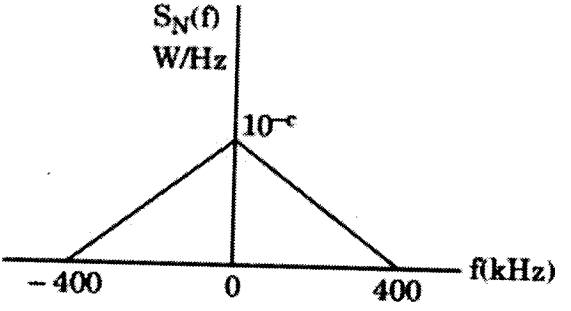

Figure 2

6. (a) Let the modulating signal be square wave that switches periodically between x(t) = + 1 and x(t) = – 1. Sketch xc(t) when the modulation AM with modulation index 0·5 and DSBSC with Indicate envelopes by dashed lines. 7

(b) Following Figure 3 is a block diagram of a transmitter for quadrature multiplexing system. Based on the individual box, predict the design of the receiver for the same and draw its block diagram : 7

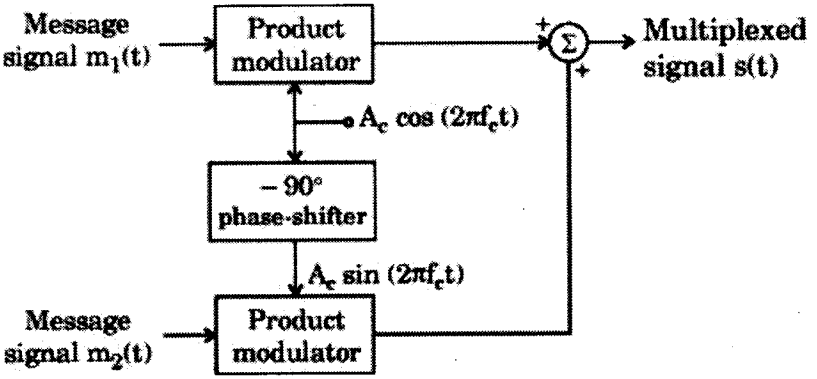

Figure 3

7. The signal $g(t) = 10 \cos (20\pi t) \cos (200\pi t)$ is sampled at the rate of 250 samples per second.

(a) Determine the spectrum of the sampled signal. 7

(b) Specify the cutoff frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version. 3

(c) Find out the Nyquist rate g(t). 4

8. (a) Following Figure 4 shows RF mixer. Based on it, draw the waveforms of the output signals at each stage : 7

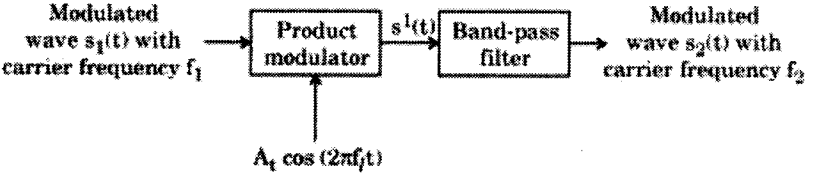

Figure 4

(b) Explain with detailed frame structure of the multiple access system to communicate on GSM system. 7

9. NASA sent the Pathfinder probe to the planet Mars. This probe had a 10 W transmitter and this resulted in a received signal power on the Earth of $P_s = -145$ dBm. Assume the receiver noise spectral density is $N_0 = -170$ dBm/Hz.

(a) What is the highest transmission rate that could possibly be achieved between the probe on Mars and the receiver on Earth ? 7

(b) If NASA did not want to interfere with other transmission in space and wanted to be bandwidth efficient and achieve $\eta_B = 2$ bits/sec/Hz, what is the highest transmission rate that can be achieved ? 7
