Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - NOV/DEC 2016

SUBJECT: ANALOG COMMUNICATION (ECE - 3103)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. A periodic signal $g_p(t)$ is defined as below with time period 2 seconds. Determine the first three terms in Fourier series expansion of this signal.

$$g_p(t) = \begin{cases} 2+\cos(2\pi t), & 0 \le t \le 1 \\ 0, & \text{remainder of the period} \end{cases}$$

1B. Consider a triangular pulse as shown in Fig. Q1B. It is passed through an ideal low pass filter of bandwidth B. Evaluate the energy spectral density and energy of the signal at the output of the filter.

1C. Let $\hat{x}(t)$ be the Hilbert transform of $x(t)$, then calculate the Hilbert transform of $\hat{x}(t)$.

(5+3+2)

2A. Determine the autocorrelation function of the triplet pulse as shown in the Fig. Q2A

2B. The gain of cascade of 3 amplifiers are G_1=10 dB, G_2 = 100, G_3 = 40dB and noise factors are F_2 = 7dB and F_3 = 13dB. The equivalent noise temperature of the first stage is 40^0 K. Determine the equivalent noise temperature of the cascade. Assume the operating temperature to be 300^0 K.

2C. Calculate the power spectral density and average power for the square wave as shown in Fig. Q2C.

(5+3+2)

3A. Consider single tone message signals $m_1(t)$ and $m_2(t)$ with frequency f_1 and f_2 respectively, assume $f_2 > f_1$. These message signal are applied to multiplexed system as shown in Fig. Q3A.The signal at point **a** is transmitted over a channel.

i. Determine the output at point a.

ii. Sketch output signal spectra at point a.

iii. Design a de-multiplexed system to recover signals $m_1(t)$ and $m_2(t)$ from the multiplexed signal (point a**)**

3B. Consider an AM modulated wave with the message signal $m(t) = 10\cos(2\pi 50t)$, carrier signal $c(t) = 50\cos(2\pi 10^5 t)$ and the modulation index 0.2. Obtain side band frequencies, amplitude of each side band, transmission band width and total power delivered to the load 600Ω. Plot the spectrum of the modulated wave.

3C. In an AM system using envelope detector, the signal at input to demodulator has the form, $v(t) = a_c \cos\omega_c t + a_m \cos\omega_m t\, cos\omega_c t + a_i \cos(\omega_c + \omega_i)t$ where $a_i \cos(\omega_c + \omega_i)t$ is unwanted interfering signal. Show that envelope detector output is $z(t) = a_m \cos\omega_m t + a_i \cos\omega_i t, when\ a_c \gg a_i$

(5+3+2)

4A. Consider a message signal *m(t)* containing frequency components at 100Hz, 200Hz and 400Hz. This signal is applied to an SSB modulator together with a carrier at 100 kHz, with only the upper side band is retained. The local oscillator used at the coherent detector to recover m(t) supplies a sine wave of frequency 100.02KHz. Determine the frequency components at the detector output.

4B. With a neat block diagram, explain FDM system.

4C. In coherent detection of DSB-SC modulated wave if local carrier is $\cos[2\pi(f_c + \delta f)t + \phi]$ obtain the expression for the demodulated wave.

(5+3+2)

5A. Explain the demodulation of FM signal using Balanced frequency discriminator method with neat block diagram and relevant expressions.

5B. Design an Armstrong FM modulator for the generation of WBFM signal with Δf = 20 kHz and fc = 96MHz, using the narrow band carrier as 200 kHz and frequency deviation 10Hz, and mixer oscillator frequency as 12.4MHz.

5C. Obtain an expression for the figure of merit of a noisy DSB-SC receiver operating with a single tone message signal.

(5+3+2)

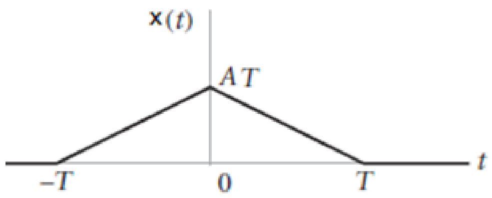

Fig Q1B

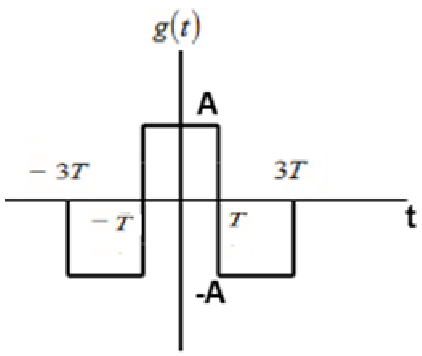

Fig Q2A

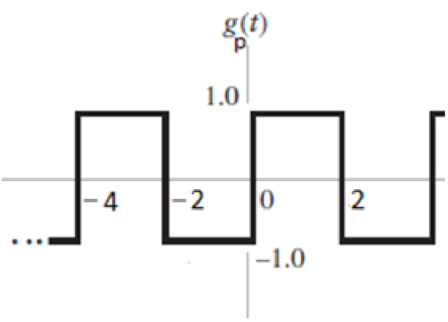

Fig Q2C

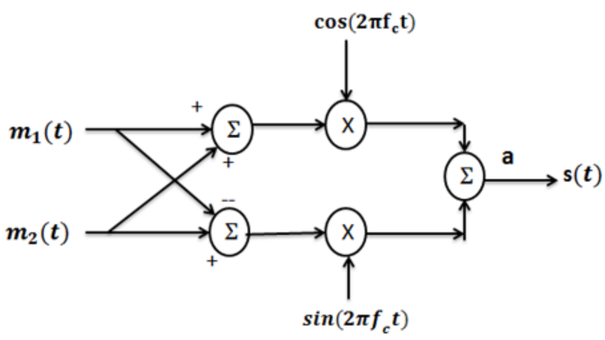

Fig Q3A