Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

FIFTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: ANALOG COMMUNICATION (ECE - 3103)

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

Instructions to candidates

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

1A. (i) Show that the Fourier Transform of a Triangular pulse of unit amplitude and unit duration (measured at half amplitude points) is equal to $sinc^2(f)$ (ii) With relevant expression, prove that Frequency-shifting is achieved by multiplying a signal g(t) by a sinusoidal signal and plot the spectrum.

1B. Using Poisson's sum formula, Find the Fourier transform of a periodic train of delta function.

1C. With relevant expression, explain the conditions for a distortion less transmission of signal through a linear time-invariant system.

(5+3+2)

2A. Show that expression for the figure of merit of a noisy AM receiver operating with a single tone modulating signal with 100% modulation is equal to $\frac{1}{3}$.

2B. Consider a signal $g(t) = A_0 + A_1\cos(2\pi f_1 t + \theta_1) + A_2\cos(2\pi f_2 t + \theta_2)$. (i) Determine the autocorrelation function of this signal (ii) what is the value of $R_g(0)$? (iii) Has any information about $g(t)$ been lost in obtaining the autocorrelation function?

2C. A power signal $x(t)$ is passed through a linear time invariant system with the impulse response, $h(t)$. Find the power spectral density of the output of the system.

(5+3+2)

3A. With relevant circuit diagram and waveforms, derive the expression for the modulated wave at the output of the square law modulator. Mention the filter specifications required to choose the modulated wave.

3B. Consider an incoming narrow band signal of bandwidth 10KHz and mid frequency that lies in the range 0.635MHz to 1.705MHz. Determine the range of tuning that must be provided in local oscillator to translate this signal to fixed frequency band centred at (i) 0.555MHz (ii) 1.85MHz.

3C. Consider three amplifiers connected in cascade with gain $G_1 = 20dB$, $G_2 = 10dB$ and $G_3 = 50dB$, Noise factors $F_2 = 11dB$ and $F_3 = 15dB$. If the equivalent noise temperature of first stage is 60^0K, determine the equivalent noise temperature of cascaded amplifier. Assume the operating temperature to be 300^0K.

(5+3+2)

4A. Consider the two stage SSB modulator using frequency discrimination method. The input signal consists of a voice signal whose spectrum is as shown in Figure Q4A. The two oscillator frequencies have the values $f_1 = 100\ kHz$ and $f_2 = 1\ MHz$. Draw the block diagram of this modulator and specify the following with proper spectra:

(i)The sidebands of the DSBSC modulated waves appearing at the two product modulators outputs.

(ii)The sidebands of the SSB modulated waves appearing at the two band-pass filter outputs.

(iii)The pass-bands and guard-bands of the two band-pass filters.

4B. A single-tone modulating wave $m(t) = A_m \cos(2\pi f_m t)$ is used to generate the VSB modulated wave $s(t) = A_m A_c[\alpha \cos(2\pi(f_c + f_m)t) + (1-\alpha)\cos(2\pi(f_c - f_m)t)]$, where α is a constant ($\alpha \leq 1$), A_c is the amplitude of carrier, and f_c is the frequency of carrier.

(i) What is the value of the constant α for which $s(t)$ reduces to a DSB-SC modulated wave? (ii) What are the values of the constant α for which *s(t)* reduces to a SSB modulated wave? (iii) Determine the distortion produced, when the VSB wave $s(t)$ plus a carrier $A_c \cos(2\pi f_c t)$ is passed through an envelope detector.

4C. Mention the necessary condition for distortion less reproduction of the information signal $m(t)$ at the output of VSB demodulator. Justify your answer.

(5+3+2)

5A. With the neat block diagram, derive the expression for demodulation of FM signal using Balanced frequency discriminator method.

5B. Design an Armstrong FM modulator for the generation of WBFM signal with Δf=100KHz and f_c=150MHz, using the narrow band carrier frequency 100KHz and frequency deviation 50Hz, and mixer oscillator frequency 3.5MHz.

5C. An angle modulated signal is described by $s(t) = 10\cos[2\pi 10^6 t + 0.1\sin(10^3)\pi t]$. Find the message signal m(t) for (i) Considering s(t) as phase modulated signal with kp=10rad/volt (ii) Considering s(t) as frequency modulated signal with k_f=5 Hz/volt.

(5+3+2)

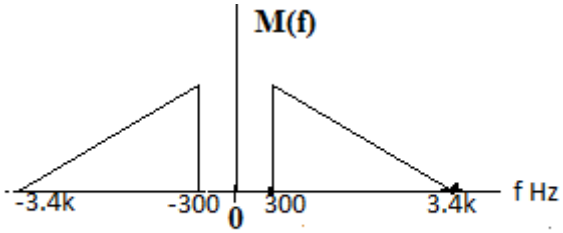

Figure Q4A