MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2015
SUBJECT: ANALOG COMMUNICATION (ECE - 301)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Evaluate the Fourier transform of $g(t) = A \, rect\left(\frac{t}{T}\right)$. Using this find the Fourier transform of the signal $f(t)$ which is obtained by integrating the signal $s(t)$ expressed as below.

$$s(t) = \begin{cases} -A & (-T \leq t \leq 0) \\ A & (0 \leq t \leq T) \end{cases}$$

1B. The PDF of a random variable 'X' is given by

$$f_X(x) = \begin{cases} k, & a \leq x \leq b \\ 0, & otherwise \end{cases}$$

where 'k' is a constant.
    i. Determine the values of 'k' in terms of 'a' and 'b'.
    ii. Let $a = -1$ and $b = 2$. Calculate $P(|X|) \leq \frac{1}{2}$.

1C. Two amplifiers are connected in cascade. For first stage, the noise figure and power gain are 5dB and 12dB respectively. For the second stage, the noise figure and power gain are 15dB and 10dB respectively. Find the overall noise figure.

(5+3+2)

2A. Given two signals $x_1(t) = [2 + A\cos(2\pi f_m t)]\cos(2\pi f_c t)$ and $x_2(t) = A\cos(2\pi f_m t)\cos(2\pi f_c t)$. If these two signals are fed to a multiplier, obtain the expression for the output signal also plot the spectrum of all the three signals.

2B. An angle modulated signal is defined by $s(t) = 10\cos(2\pi 10^6 t + 0.2\sin 2000\pi t)$. Calculate (a) Power in modulated signal (b) Frequency deviation (c) Phase deviation (d) Approximate bandwidth.

2C. Prove that modulation index $\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$ for a standard AM wave, where A_{max} and A_{min} are the maximum and minimum amplitude of the AM wave.

(5+3+2)

3A. Consider the message signal $m(t) = \cos(100\pi t) + \cos^2(100\pi t) + \sin(400\pi t)$ is applied to an SSB modulator having carrier of 100KHz with upper sideband retained. In the coherent detector used to recover $m(t)$, the local oscillator supplies a sine wave of frequency 100.02KHz. Obtain the time-domain expression for SSB wave and output of the coherent detector. Also determine and sketch the spectrum of the demodulated wave.

3B. Define Figure of merit of a receiver. Derive an expression for figure of merit of a SSB receiver.

3C. With relevant block diagram explain the working of FM radio receiver.

(5+3+2)

4A. Draw the circuit diagram of switching modulator. With the relevant expressions, show that it can be used to generate standard AM signal. Mention the specifications of the filter used to extract the required signal.

4B. Find the energy spectral density for the signal shown in Fig.Q.No.4(B).

4C. The PDF of a random variable 'X' is given as $f_X(x) = ae^{-b|x|}$, with allowable values of 'X' range from x = -∞ to x = +∞. Find CDF of 'X' and plot the same.

(5+3+2)

5A. Find cross correlation $R_{12}(\tau)$ between the signals $g_1(t)$ and $g_2(t)$ shown in Fig. Q.No.5(A).

5B. Draw the block diagram of Quadrature amplitude modulator and demodulator. List its advantages.

5C. A random variable X has probability density function,

$$f_X(x) = \begin{cases} \dfrac{5(1-x^{4)}}{4} & , \quad 0 \le x \le 1 \\ 0 , elsewhere \end{cases}$$

Find mean and second moment of it.

(5+3+2)

6A. Starting from the definition, obtain the spectrum of an FM signal for single tone modulation. Hence define narrow-band and wide-band FM waves.

6B. An audio frequency signal $10\cos(100\pi t)$ is amplitude modulated by the carrier signal $50\cos(20000\pi t)$. Given $\mu = 0.2$, calculate side band frequencies, band width of AM, total power delivered to the load 600Ω. Plot the spectrum of the modulated wave.
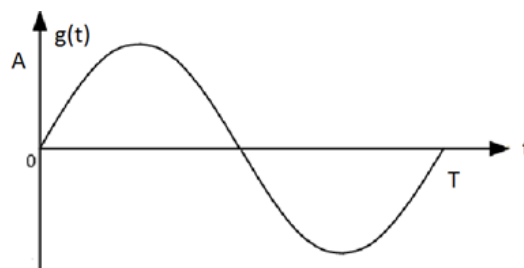
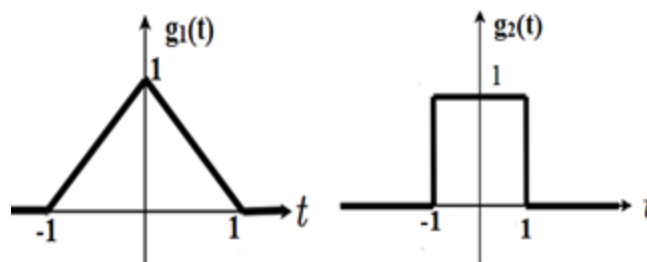6C. Mention the properties of power spectral density.

(5+3+2)

Fig.Q.No.4(b)

Fig. Q.No. 5A