Department of Electronics & Communication Engineering

NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA

MID-SEMESTER EXAMINATION Autumn 2011

CLASS: B.Tech, 5th sem (EC & EI) TIME: 2hours

SUBJECT: **ACS** M.M: 30

SUBJECT CODE: **EC311**

Answer all questions

Figures in the right hand margin indicate marks

All parts of a question should be answered in one place

Q No			Marks
1	a	The joint density function of two continuous random variables is $p_X(x,y) = \begin{cases} Cxy & 0 < x < 2,\ 1 < y < 3 \\ 0 & otherwise \end{cases}$ Find (a) C (b) $P(0 \le X \le 1, 1 \le Y \le 2)$ (c) $P(X \le 1, Y \le 2)$ (d) Marginal distribution functions of X and Y (e) Joint distribution function of X and Y (f) $P(X + Y \le 3)$	6
	b	Discuss the random variable in detail. In a random experiment, a trial consists of five successive tosses of a coin. If we define a random variable X as the number of heads appearing in the trial, determine the probability distribution function $P_X(x)$	4
2	a	Design an Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency of 98.1MHz and $\Delta f = 75KHz$. A narrow band FM generator is available at a carrier frequency of 100KHz and frequency deviation $\Delta f = 10Hz$. The stock room also has an oscillator with the adjustable frequency in the range of 10 to 11 MHz. There are also a plenty of frequency doublers, triplers and quintuplers	4
	b	Given $m(t) = \exp(-t^2)$, $f_c = 10^4 Hz$, k_f = [illegible] and k_p = [illegible] (a) find Δf, the frequency deviation for FM and PM (b) estimate the bandwidth for FM and PM waves βf_m	3
	c	Sketch the PM and FM waves produced by the saw tooth wave shown in figure	3

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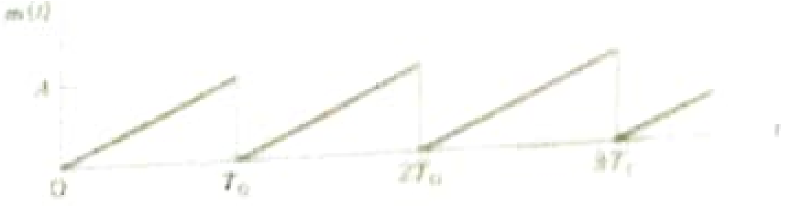

Using small error analysis, show that a first order loop can not track an incoming signal whose instantaneous frequency is varying linearly with time (i.e. $\theta(t) = kt^2$). Show that this signal can be tracked within a constant phase if loop-filter is a leaky integrator. Also show that it can be tracked with a zero phase error if loop transfer function is $F(s) = \frac{s^2 + as + b}{s^2}$

b. Discuss the principles of the followings

(a) Ring modulator
(b) Costas receiver
(c) Envelop detector