Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Analog Communication

Time: 3 hrs.   Max. Marks:100

Note: *Answer FIVE full questions, selecting
at least TWO questions from each part.*

PART – A

1 a. Define and give expressions for
   i) Joint density function.
   ii) Conditional density functions.
   iii) Marginal density functions.   **(06 Marks)**

   b. Is the function $fx(x) = 2e^{-2x}$ for $x \geq 0$ a PDF? If so find the probability that it will take a value between 1 and 3.   **(04 Marks)**

   c. Define auto correlation function. State and prove the properties of ACF (Auto Correlation Function). Express ACF in terms of auto covariance function.   **(10 Marks)**

2 a. Explain with equations and frequency spectrum, the generation of AM with square law modulator. Take $m(t) = A_m \cos wmt$ to draw spectrum.   **(08 Marks)**

   b. What do you mean by coherent detection? What is quadrature null effect?   **(04 Marks)**

   c. An amplitude modulated voltage is given is $V=50(1 + 0.2\cos 100t + 0.01\cos 3500t)\cos 10^6 t$. State all frequency components present in AM signal. Find modulation index for each modulating voltage term. What is effective modulation index? Find the efficiency of modulation.   **(08 Marks)**

3 a. What is bandpass signal? Derive canonical representation of BPS. Draw phasor diagrams and block diagrams to show how BPS can be represented with lowpass signals.   **(10 Marks)**

   b. Consider two stage SSB modulator. The input signal consists of voice signals occupying the frequency band 0.3 to 3.4 kHz. The two oscillator frequencies have values $f_1 = 100$ kHz and $f_2 = 10$ MHz. Specify the following:
   i) The sidebands of DSB-SC wave appearing at the two product modulator outputs.
   ii) The sidebands of SSB modulated wave appearing at the two bandpass filter output.
   iii) The pass band and guard bands of the two bandpass filters.   **(10 Marks)**

4 a. Derive time domain expression for vestigial sideband modulated signal.   **(10 Marks)**

   b. With neat block diagram, explain the operation of a superheterodyne receiver.   **(10 Marks)**

PART – B

5 a. What is Carson's rule? Show that it applies both to narrow band and wide and FM.   **(04 Marks)**

   b. An angle modulated signal is described by $s(t) = 10 \cos[2\pi 10^6 t + 0.1 \sin 10^3 t]$. Find the message signal $m(t)$.
   i) Considering $s(t)$ as phase modulated signal with $K_p = 10$.
   ii) Considering $s(t)$ as frequency modulated signal with $k_f = 5$.   **(06 Marks)**

   c. In a two stage wideband frequency modulator, $f_1 = 200$ kHz. Maximum phase deviation is taken as 0.2 rad to avoid distortion. Modulating signal range from 50 Hz to 15 kHz. The carrier frequency at the output is 108 MHz. Select multipliers and mixer oscillator frequency. Tabulate fc and Δf at each stage.   **(10 Marks)**

6 a. Explain with help of block diagram stereo multiplexing. (08 Marks)

b. What is a PLL? Assuming linear model for PLL, explain with expressions, how PLL can be used as FM detector. (12 Marks)

7 a. Define:
   i) Noise equivalent BW.
   ii) Equivalent noise temperature.
   iii) White noise. (07 Marks)

b. Derive Friis transmission formula. (07 Marks)

c. Two resistors 20KΩ and 50 KΩ are at room resistors 20KΩ and 50KΩ are at room temperature (290°K). For the band width of 100kHz, calculate the thermal noise for the following conditions:
   i) For each resistor.
   ii) Two resistors in series.
   iii) Two resistors in parallel. (06 Marks)

8 a. Derive the expression for figure of merit for AM receiver with envelope detector. If single tone modulating signal is considered, what is figure of merit? (10 Marks)

b. What is capture effect in FM? Given $\beta = 20$, find figure of merit for FM with single tone modulating signal. (05 Marks)

c. What is improvement ratio in FM receiver? Show that $I = \dfrac{2w^3}{3 \displaystyle\int_{-w}^{w} f^2 \left| H_{DE}(f) \right|^2 df}$. Where

$H_{DE}(f)$ is transfer function of deemphasis network. (05 Marks)

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