53 (EC 402) ANCM

2017

ANALOG COMMUNICATION

Paper : EC 402

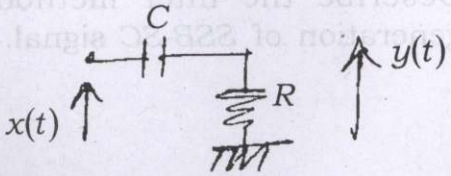
Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* $x(t)=exp(-t/\tau)u(t)$ is applied as input to an *L*-section high-pass RC filter with time constant of 'τ' seconds. Find the energy spectral density (ESD) at the output of the filter. Also express the output signal energy as a percentage of the input signal energy. 8+2



(b) The figure shown below is a scheme for generating a conventional *AM* signal. Let us choose $m(t)=cos\left(2\pi 10^3 t\right)$ and $c(t)=cos\left(2\pi 10^6 t\right)$. 5+5

(i) Obtain an expression for the modulation index of the *AM* signal.

(ii) For a modulation index of 90% and PEP (normalised, i.e., acroes 1Ω) of $100W$, find the value of the amplifier gains A and B.

2. (a) A conventional *AM* signal is expressed by $x_{AM}(t)=[1+\alpha\cos(\omega_{mt})+\alpha\cos(2\omega_{mt})]\cos(w_{ct})$; $\alpha\geq 0$. Prove that, to avoid distortion $\alpha\leq 8/9$. 10

(b) Derive the condition on the filter transfer function necessary to demodulate a *VSB* signal. Hence draw the filter transfer function. 10

3. (a) Describe the filter method for the generation of *SSB-SC* signal. 10

(b) For a balanced ring modulator circuit, the carrier frequency is 500*kHz* and the modulating signal frequency ranges from 0 to 5*kHz*. Determine the output frequency range. 4

(c) Describe the theory behind a ring-modulator circuit. Why the carrier component cannot produce an output voltage when the modulation is absent? 6

4. (a) Discuss the generation of *WBFM* using a reactance modulator circuit. 10

(b) Explain the working principle of a Foster-Seeley discriminator circuit. 10

5. (a) Prove that a narrowband phase modulation is similar to *AM* signal. 8

(b) Discuss Carson's rule for bandwidth. 4

(c) Show that for an *AM* system with envelope detector, the figure of merit *(FOM)*, i.e., the ratio of destination *SNR* to the channel *SNR* is given by

$$F.O.M. = \frac{m^2\overline{x^2}}{1+m^2\overline{x^2}}$$; where *'m'* is the modulation depth and *'x'* is the *AM* signal. 8

6. Write short notes on ***any two*** from the following : 10+10

(i) Relation between rise-time and band-width for a first order system.

(ii) Direct a Armstrong method for generation of *WB* angle modulated signal.

(iii) Quadrature FM demodulator.