53 (EC 402) ANCM

2019

ANALOG COMMUNICATION

Paper : EC 402

Full Marks : 100

Time : Three hours

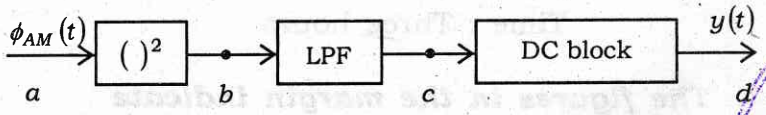
The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions.*

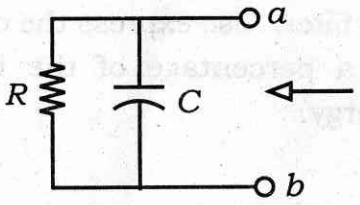
1. *(a)* $x(t) = exp(-t/\tau) \cdot u(t)$ is applied as input to an *L*-section high pass RC filter with time constant of 'τ' *sec.* Find the energy spectral density (ESD) at the output of the filter. Also express the output signal as a percentage of the input signal energy. 8+4

Contd.

(b) In the early days of radio, AM signals were demodulated by a crystal detector followed by an LPF and a dc-blocker shown in the figure below. Assume a crystal detector to be basically a squaring device, calculate the signals at points *a*, *b*, *c* and *d*. Find the distortion turn in the output $y(t)$. Show that if $A >> |m(t)|$ the distortion will be small. 8



2. (a) If the input noise power spectral density (PSD) because of thermal noise is given by $S_n(f) = 2kTr$; show that the rms thermal noise voltage across the capacitor is $\sqrt{kT/C}$, where symbols have their usual meanings. 15



(b) A broadcast radio transmitter radiates $5kW$ power when the modulation percentage is 60%. What is the value of the carrier power? 5

3. (a) An FM carrier is sinusoidally modulated. When does all the power lie in the sidebands (i.e., no power lie in the carrier component)? 10

(b) Show that the Hilbert transform of a signal changes the phase of the input signal by $\pm 90°$. 10

4. (a) Explain the working principle of a Foster-Seeley discriminator circuit. What is meant by a frequency discrimination? 10+2

(b) Show the relationship between the transmission bandwidth 'B_T' and the modulation depth 'β' of FM and PM signals using Carson's rule. 8

5. (a) Prove that a narrowband PM is similar to an AM signal. 12

(b) Show that a linearised PLL can demodulate an FM signal. 8

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

(i) Quadrature FM demodulator

(ii) Pre-emphasis and de-emphasis filtering

(iii) Quadrature amplitude modulation (QAM)

(iv) Noise equivalent bandwidth.