Total No. of printed pages = 4

19/4th Sem/UECE 401

2022

ANALOG AND DIGITAL COMMUNICATION

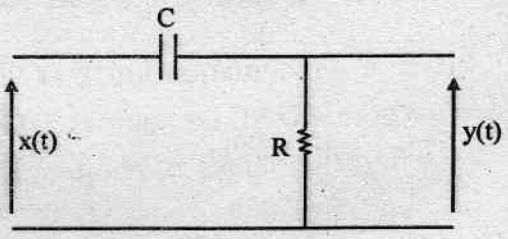
Full Marks – 100

Time – Three hours

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

Answer any *five* questions.

1. (a) $x(t) = e^{\frac{t}{\tau}} \times u(t)$ is applied as input to an L-section high-pass RC filter with a 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. 7+3



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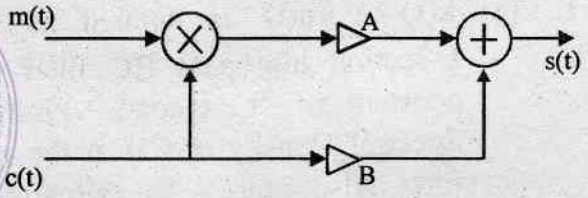
(b) Prove that the system bandwidth (B) and rise time (t_r) are related by $t_r \cong \frac{0.35}{B}$; where the symbols have their usual meaning. 10

2. (a) Discuss the operation of a balance modulator in connection with the generation of DSB-SC signal. How the circuit is capable of suppressing the effect of carrier alone ? 8+2=10

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



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

(ii) For a modulation index of 90% and PEP (normalized, i.e., across 1 Ω) of 100 W, find the values of the amplifier gains A and B. 4+6=10

3. (a) Show that Hilbert transforming an input signal is equivalent to change its output phase by ± 90 deg. 8

(b) Derive the condition on the filter transfer function necessary to demodulate a VSB signal. 12

4. (a) Derive the time domain representation of upper single sideband modulated suppressed carrier signal (USSB-SC). 10

(b) Find the frequency domain representation of both the USSB-SC and the LSSB-SC signal in terms of the analytic signal. 10

5. (a) Show that a Narrow Band Phase Modulated signal (NBPM) is similar to AM. 8

(b) Discuss the direct method of generation of WBFM (Wide Band Frequency Modulation) using reactance modulator. 12

6. Write short notes on any *two* from the following : 10×2=20

(a) Capture effect in FM.

(b) Foster-Seeley FM discriminator.

(c) Relation between modulation index (m) and the modulating signal frequency (ω_m) in absence of diagonal clipping.

(d) Super heterodyne receiver.