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Paper Code : EC401 Analog Communication

UPID : 004451

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]

(I) An Amplifier generating no noise should have a Noise Figure of _____

(II) Which component is not common between a tuned radio frequency (TRF) receiver and Super-heterodyne receiver?

(III) The FCC assigned frequency range for AM broadcasting is ----------

(IV) FM signal is a narrow band FM (NBFM), if modulation index is _____

(V) When Gaussian noise passed through the IF amplifier, then the PDF of the output envelope is given by _____

(VI) What is quadrature null effect in synchronous detection technique?

(VII) What is PSD of White Noise?

(VIII) What is the low-level carrier called that is sometimes transmitted along with the two sidebands in DSB?

(IX) A Super heterodyne receiver with I.F of 450 kHz is tuned to a signal at 1200 kHz. Calculate the Image Frequency.

(X) In order to get good S/N ratio at the destination, the practical FM broadcasting stations use modulation indices (i.e., β values) of the order of _____

(XI) The image channel rejection in a super heterodyne receiver comes from _____ stage only.

(XII) In a modulation system, on doubling the modulation frequency, the modulation index gets halved while the modulating voltage needed remains unaltered. The modulation system is _____

Group-B (Short Answer Type Question)

Answer any three of the following : [5 x 3 = 15]

2. What are the advantages of modulation in communication systems? Explain three main reasons with proper example. [5]

3. How AM signal can be detected with Synchronous Detector. [5]
Sketch the time and frequency domain representation of baseband, carrier, DSB-SC, DSB+C signal.

4. A diode detector has a load of 1 kΩ shunted by a 10000 pF capacitor. The diode has a forward resistance of 1 Ω. Find the maximum permissible depth of modulation, so as to avoid diagonal clipping, with modulating signal frequency 10 kHz. [5]

5. Explain the demodulation of FM signal using a Dual-Slope Detector Circuit. [5]
(use necessary circuit diagram & graphical representation of circuit response with frequency)

6. 24 voice signals are sampled uniformly and then time division multiplexed (TDM). The sampling operation uses flat top samples with 1μs duration. The multiplexing operation includes provision for synchronization by adding an extra pulse of appropriate amplitude and 1μs duration. The highest frequency component of each voice signal is 3.4 kHz. Assuming sampling rate of 8 kHz, Calculate the spacing between successive samples of multiplexed signals. [5]

Group-C (Long Answer Type Question)

Answer any three of the following : [15 x 3 = 45]

7. (a) Prove that Fourier transform of $\mathbf{f(t)\cos(\omega_o t)}$ is $\mathbf{\frac{1}{2}[F(\omega-\omega_o) + F(\omega+\omega_o)]}$, where F(ω) is the Fourier transform of f(t) [5]

(b) Show that: $\mu = (E_{max}-E_{min})/(E_{max}+E_{min})$, for single tone AM signal. Where, E_{max} &E_{min} are the max and min amplitude of the AM wave envelope. [5]

(c) A 2 MHz carrier is amplitude modulated by a 500 Hz modulating signal to a depth of 70%. If the unmodulated carrier power is 2 kW, then calculate the power of the modulated signal. [5]

8. (a) [5]

What is VSB? Draw the block diagram of VSB modulator and demodulator. What are the advantages of VSB over DSB and SSB?

(b) What is the function of AGC in Superheterodyne receiver? What is Delayed AGC? Why it is required? [5]

(c) A super heterodyne receiver is designed to receive transmitted signals between 5 and 10 MHz. High-side tuning is to be used. Find the tuning range of the local oscillator (LO) for IF frequency 500 kHz. [5]

9. (a) Draw the phasor diagram of a typical AM, DSB-SC and SSB-SC signals with explanation. [5]

(b) Draw the Spectral representation of DSB-SC, DSB-FC, SSB-SC, SSB-FC and VSB-SC signals. [5]

(c) A certain transmitter (AM) is radiating 132kW when a certain audio sine wave is modulating it to a depth of 80% and 150kW when a second sinusoidal audio wave also modulates it simultaneously. What is the depth of modulation for the second audio wave? What is the overall % of modulation? [5]

10. (a) Show that the envelope detector output will follow the envelope if it satisfies $RC \leq \sqrt{(1-\mu^2)} / (\mu\omega_m)$, where the symbols carry their usual meaning. [5]

(b) A diode detector load consists of 0.01μF capacitor in parallel with a 5Kohms resistor. Calculate the maximum depth of modulation without diagonal clipping at modulating frequency of 1000 Hz and 10 KHz. [5]

(c) Compare the merits and demerits of Filter method of SSB-SC generation. How do you overcome the limitations of the above mentioned method? [5]

11. (a) Describe the effect of variation of modulation index , β on the spectrum of FM signal. [5]

(b) Derive Carson's Rule regarding FM signal bandwidth. [5]

(c) A modulating signal $5 \cos 2\Pi 15 \times 10^3 t$, angle modulates a carrier $A \cos \omega_c t$. [5]

(i) Find modulation index (β) and bandwidth for both FM and PM signβal.

(ii) Determine the change in the bandwidth and the modulation index for both FM amd PM, if f_m is reduced to 5 kHz.

Assume: $K_p = K_f = 15$ kHz/V.

*** END OF PAPER ***