

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EIE)/SEM-5/EC-511(EI)/2009-10****2009****ANALOG COMMUNICATION THEORY**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.***GROUP - A****( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any ten of the following :

$$10 \times 1 = 10$$

i) If  $X(f)$  be the Fourier Transform of  $x(t)$ , then the Fourier transform pair of  $x(t) e^{j2\pi f_0 t}$  is .

- a)  $X(f - f_0)$                       b)  $X(f_0 - f)$   
 c)  $X(f + f_0)$                       d)  $X(f_0)$ .

ii) The Channel Capacity of a communication system is

- a)  $B \log_{10}(1 + \text{SNR})$               b)  $B \log_2(1 + \text{SNR})$   
 c)  $B \log_{10}(1 + \text{SNR})^{-1}$           d)  $B \log_e(1 + \text{SNR})$ .

55708

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CS/B.Tech(EIE)/SEM-5/EC-511(EI)/2009-10

- iii) Which is not the purpose of modulation ?
- a) Increase in signal power
  - b) Multiplexing
  - c) Effective radiation
  - d) All of these.
- iv) The main advantage of super heterodyne receiver is
- a) simple circuit
  - b) better tracking
  - c) improvement in selectivity and sensitivity
  - d) all of these.
- v) The maximum transmission efficiency of AM is
- a) 33.33%
  - b) 50%
  - c) 66.6%
  - d) 100%.
- vi) A DSB-SC signal is being detected synchronously. The phase error in the locally generated carrier will
- a) cause phase delay
  - b) cause phase distortion only
  - c) have the effect of reducing the output and cause phase distortion also
  - d) reduce the detected output only.
- vii) The main advantage of TDM over FDM is that it
- a) needs less power
  - b) needs less BW
  - c) needs simple circuit
  - d) gives better signal to noise ratio.

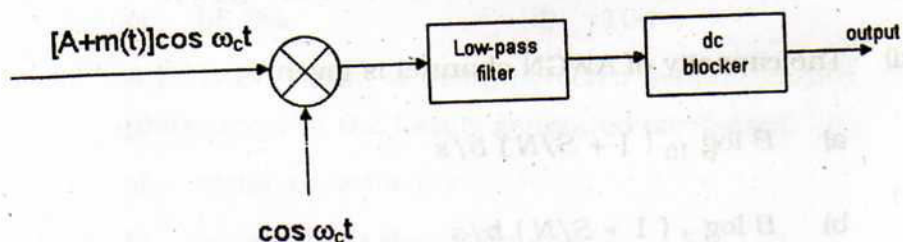
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- viii) The communication medium causes the signal to be
- amplified
  - modulated
  - attenuated
  - interfered with.
- ix) QAM modulator needs a phase shifter of phase shift
- $\pi/6$
  - $\pi/4$
  - $\pi/3$
  - $\pi/2$ .
- x) If  $h(t)$  be the impulse response of a system, then for an input  $g(t)$ , the output is given by
- $h(t) * \delta(t)$
  - $h(t) \delta(t)$
  - $[h(t) * \delta(t)]^{-1}$
  - $h(t) * g(t)$ .
- xi) The capacity of AWGN channel is given by
- $B \log_{10} (1 + S/N) \text{ b/s}$
  - $B \log_2 (1 + S/N) \text{ b/s}$
  - $B \log_{10} (1 + N/S) \text{ b/s}$
  - $B \log_2 (1 + N/S) \text{ b/s}$ .
- xii) Varactor diode is used for
- FM generation
  - AM generation
  - PM generation
  - All of these.

CS/B.Tech(EIE)/SEM-5/EC-511(EI)/2009-10

**GROUP - B****( Short Answer Type Questions )**Answer any *three* of the following.  $3 \times 5 = 15$ 

2. a) What do you mean by figure of merit (  $\gamma$  ) ?  
 b) Calculate the figure of merit (  $\gamma$  ) for DSB-SC modulation.  $1 + 4$
3. a) Explain the DSB-SC modulation technique using a single frequency sinusoidal signal ( tone ) as baseband signal.  
 b) Figure shows a scheme for coherent ( synchronous ) demodulation. Show that this scheme can demodulate the AM signal  $[ A + m ( t ) ] \cos \omega_c t$  regardless of the value of A.  $3 + 2$



4. a) Define modulation index and efficiency of modulation. How can AM modulation be determined ( i.e. under modulation, critical modulation and over-modulation ) according to modulation index ?  
 b) Show that maximum efficiency of transmission is 33.33%.  $3 + 2$
5. a) Explain the concept of negative frequency.  
 b) Define Energy and Power of a signal.  $2 + 3$

55708

4

CS/B.Tech(EIE)/SEM-5/EC-511(EI)/2009-10

6. a) Defined Carson's rule for bandwidth requirement in FM.
- b) Consider a FM modulated signal  $X_{FM}(t) = 10 \cos(\omega_c t + 3 \sin \omega_m t)$ , if the frequency of the modulating signal  $f_m = 1$  kHz. Calculate the modulation index and find the bandwidth, when
- $f_m$  is doubled and
  - $f_m$  is decreased by one half. 1 + 4

**GROUP - C****( Long Answer Type Questions )**Answer any *three* of the following. 3 × 15 = 45

7. a) What are the conditions for distortion less transmission through LTI system ? Explain with amplitude and phase responses.
- b) Show that ideal low pass filter is unrealizable i.e. it is a non-causal system. How do you convert it to a causal system ?
- c) A low pass filter transfer function  $H(\omega)$  is given by
- $$H(\omega) = (1 + k \cos T\omega) e^{j\omega t_d} \text{ for } |\omega| \leq \omega_m \text{ and}$$
- $$H(\omega) = 0 \text{ for } |\omega| > \omega_m$$
- A pulse  $x(t)$  band limited to  $\omega_m$  rad/s is applied at the input of this filter. Find the output  $y(t)$ .
- Draw  $|H(\omega)|$ ,  $\theta_h(\omega)$ ,  $x(t)$  and  $y(t)$ . 5 + 5 + 5

CS/B.Tech(EIE)/SEM-5/EC-511(EI)/2009-10

8. a) What do you mean by balance modulator ?
- b) What are the main conditions in envelope detection method in connection with demodulation of AM ?
- c) How AM signal can be detected using envelope detector ? What do you mean by diagonal clipping ?
- d) For tone modulation, determine the upper limit of time constant (  $RC$  ) to ensure that the capacitor voltage follows the envelope.
9. Define SNR and Noise figure. Calculate the overall noise figure and equivalent noise temperature of two systems connected in cascade. How will the relationship be modified if the number of stages be increased from two to  $n$  in cascade ? Why is the noise performance of the first stage so important ? If each stage of a two-stage cascade amplifier has a gain of 10 dB and noise figure of 10 dB, calculate the total noise figure in dB.
10. a) Draw and explain the operation of a super-heterodyne receiver. What is image frequency ?
- b) In an FM system when the audio frequency is 410 Hz and AF voltage is 2.7V, the frequency deviation is 3.6 kHz. If the AF voltage is changed and raised to 7.8V, what is the new deviation ? Find modulation index in each case.
- c) The band width of FM is infinite. Justify.

$$4 + 2 + (4 + 1) + 4$$

$$3 + 6 + 2 + 2 + 2$$

$$2 + 6 + 2 + 3 + 2$$

11. Write the short notes on any *three* of the following :  $3 \times 5$

- a) Costa's Loop or Costa's Receiver
  - b) Ring Modulator
  - c) Distortion due to multipath effect
  - d) Automatic Gain Control ( AGC )
  - e) Pre-emphasis and De-emphasis.
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