

The Open University of Sri Lanka
Department of Electrical and Computer Engineering
Final Examination 2004/2005
ECD2202 – Radio Communications



033

Time: 0930 – 1230 hrs.

Date: 2006 – 05 - 06

Answer any FIVE questions

1.

(a) An amplitude modulated signal is given by

$$E = E_c (1 + m \cos \omega_m t) \cos \omega_c t$$

- (i) Expand the above expression and identify the carrier and the side bands.
 - (ii) Find the carrier power P_c , the power of the side bands P_s and the ratio $\frac{P_t}{P_c}$, where P_t is the total power of the signal.
 - (iii) Sketch the frequency spectrum of the signal.
- (b) A 2 kW carrier is amplitude modulated to a depth of modulation of 70%. Find
- (i) the total power of the signal.
 - (ii) the side band power.
- 2.
- (a) A sinusoidal carrier (C) is frequency modulated using an audio signal (A). The carrier frequency is deviated by Δf due to modulating voltage V (amplitude of the audio signal). What relationship exists between Δf and V ? Sketch Δf vs. V .
- (b) In a FM system the frequency deviation Δf due to an audio signal of 3 V is 5 kHz. Audio signal frequency is 600 Hz.
- (i) Find the frequency deviation if the Audio voltage is increased to 7 V.
 - (ii) If the Audio voltage is increased to 12 V while the frequency of the audio signal is reduced to 350 Hz, find the new frequency deviation.
 - (iii) Find the modulation index for (b) (ii).

3.

- (a) With reference to Pulse Code Modulation (PCM), explain following terms:
- (i) Sampling.
 - (ii) Digitizing / quantizing.

(iii) Quantization error.

(b) A signal is pulse code modulated into 7-bit words (no parity bit). The quantization error is 2 mV.

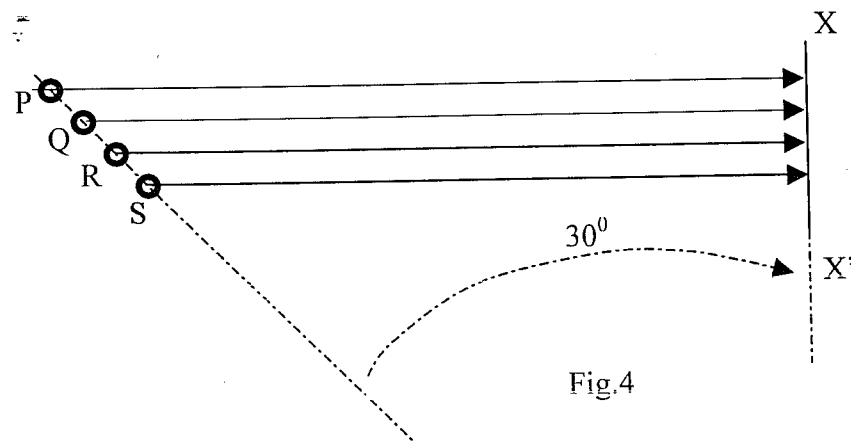
(i) Calculate the no. of quantization levels.

(ii) Find voltage range of the signal.

(c) A certain channel exhibits ideal low-pass characteristics. If a rectangular pulse is transmitted over this channel, sketch the approximate shape of the pulse at the receiver. Justify this shape.

4.

(a)



An antenna array consists of four identical vertical dipoles P, Q, R and S as shown in fig.4. P, Q, R and S are fed in parallel by a R.F. transmitter. Radiated power from the antennae is incident perpendicularly on a short iron rod XX' as shown in the figure. If the electric field strength of P on XX' is E_0 , find the total field strength E at the iron rod (find both magnitude and the direction). The angle between the line joining P, Q, R, S and the iron rod is 30° .

(b) Define following terms for a transmitting antenna

(i) radiation pattern

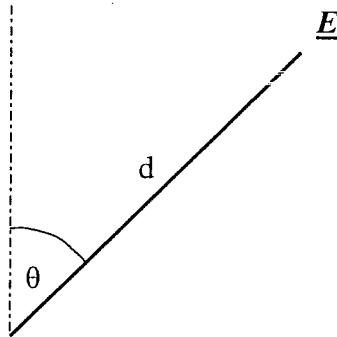
(ii) antenna gain

(iii) directivity

5.

- (a) A ground antenna is used to transmit a signal to ionosphere. The magnitude of the field strength (E) at a distance d at an angle θ with vertical is given by

$$E = E_0 \cos^2 \theta, \text{ where } E_0 \text{ is a constant.}$$



- (i) Sketch the radiation pattern
(ii) Find the beam-width of the antenna
- (b) An isotropic antenna transmits signal power of P_0 . Calculate the power density (p_d) at a distance r from the transmitting point. Sketch the variation of p_d with r .

6.

- (a) Name major noise sources in electronic circuits.
- (b) Write down an equation for the noise generated in a resistor. Assume that the absolute temperature of the resistor is T and the bandwidth over which the resistor operates is Δf .

A $12 \text{ k}\Omega$ resistor is connected to the input of an amplifier. If the amplifier operates in the frequency range $10 \text{ MHz} - 15 \text{ MHz}$, calculate the r.m.s value of the noise voltage generated at the amplifier input.

(room temperature = 27°C ; Boltzmann's constant $k = 1.38 \times 10^{-23} \text{ J / K}^0$)

- (c) (i) What is understood by *Noise Figure* of an amplifier?
If two amplifiers with noise figures F_1 and F_2 are connected in cascade, what is the overall noise figure of the amplifier system?
- (ii) A receiver has a noise figure of 12 dB . A preamplifier with a gain 10 dB is added to the receiver, in order to improve the receiver performance. What is the overall noise figure of the combination?

7.

- (a) Why is the input R.F signal converted into an intermediate frequency (IF frequency) before the demodulation is carried out in the case of a super heterodyne receiver?
- (b) Give reasons for the following:
- (i) The built-in antenna of a domestic TV receiver is connected to the signal input of the TV using a ribbon type cable (not a coaxial cable!).
- (ii) A dipole (folded type) domestic roof antenna is connected to the TV receiver input using a coaxial type cable (not a ribbon type cable!)
- (c) What is understood by *Chrominance Signal* and *Luminance Signal* in TV transmission? Give the composition of *Luminance Signal*.

8.

Describe briefly the following

- (a) effect of the curvature of earth on troposphoric wave transmission.
- (b) circularly polarized wave.
- (c) principle of class C operation of an amplifier.
- (d) reflection mechanism of ionospheric waves at the ionosphere.
- (e) log periodic antenna.

