The Open University of Sri Lanka
Department of Electrical and Computer Engineering
Final Examination 2005 / 2006
ECD2203 – Line Communications

Time: 1330 – 1630 hrs. Date: 2006- 05 - 16

Answer any FIVE questions

1.

(a) Consider the filter given in fig.1

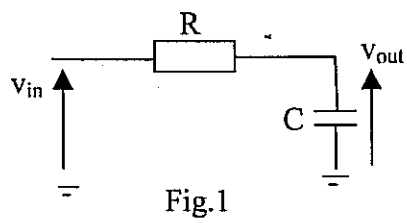

Fig.1

(i) If v_{in} is pure sinusoidal write an expression for the transfer function of the signal. Name the type of the filter. Justify your answer.

(ii) Draw the frequency characteristics of the filter. Derive an expression / expressions for cutoff frequency / frequencies.

(iii) What is the bandwidth of the filter?

(b) Sketch the output frequency characteristics of the above filter if a rectangular pulse is applied at the input (pulse width = RC).

2.

(a) Design a Bridged –T null network to following specifications:

$\omega = 2 \times 10^4$ radians / s
Q of the inductance $L_s = 100$
$R = 1\ k\Omega$

(b) Design a L-network to match the impedances $R_s = 220\ \Omega$, $R_L = 110\ \Omega$.

3.

(a) Briefly explain the design principle of an equalizer (e.g. for a open wire section).

(b) It is necessary to design an equalizer for a transmission cable whose transfer function is expressed by

$$F(\omega) = \frac{1}{\sqrt{1+\left(\frac{\omega}{\omega_0}\right)}}$$

(i) Find the approximate value of $F(\omega)$ when

(α) $\left(\frac{\omega}{\omega_0}\right) << 1$ (β) $\left(\frac{\omega}{\omega_0}\right) = 1$ (γ) $\left(\frac{\omega}{\omega_0}\right) >> 1$

(ii) Find the approximate value of $10\log(F(\omega))$ for $\frac{\omega}{\omega_0}$ = 0.1, 10, 100, 1000, 10000 and 100000

(iii) Find the slope of $F(\omega)$ in dB / octave (change of $F(\omega)$ in dB when $\left(\frac{\omega}{\omega_0}\right)$ is increased by a factor 10) for larger $\left(\frac{\omega}{\omega_0}\right)$ values.

(iv) If the overall loss (cable loss + equalizer loss) to be approximated to 0 dB, give the loss characteristics of the equalizer.

4.

(a) Explain how line faults in a line can be located.

(b) The oscilloscope display of a pulse-echo test is shown in fig.4.

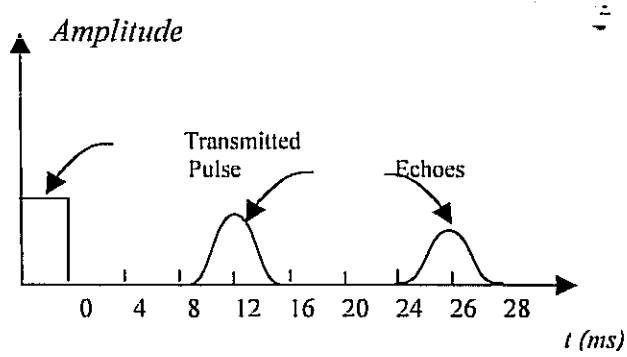

Fig.4

(i) Does the line act as a low pass filter or a high pass filter? Justify your answer using Fig.4.

(ii) How many line faults are there? Locate the fault distance(s).
(Assume that the generator frequency is 10 kHz and the phase constant is 0.03 radians per kilo meter)

5.

(a) The phase constant β of a certain transmission line of length *d* is related to its' source frequency as follows:

$$\beta(\omega) = \sqrt{\frac{\omega^2 + a}{2}}$$ where ω is the angular frequency and a is constant.

Find the group velocity (v_g) of the line.

(b) A voltage source E cos(ωt) is applied to the input of a transmission line whose attenuation constant and the phase constant are α and β respectively.

(i) Write down an expression for the propagation constant (γ).

(ii) Write down an expression for the voltage level at a distance *d*.

6.

The operating frequency of a 150 km long transmission line is100 MHz.
Line parameters are as follows:

$R = 10\ \Omega\ km^{-1}$; $L = 2$ mH km^{-1};
$G = 2\ \Omega^{-1}\ km^{-1}$; $C = 10$ nF km^{-1};

If a sinusoidal source is connected to the line input, calculate:

(i) the characteristic impedance (Z_0) of the line.

(ii) the attenuation constant(α) and the phase constant (β).

(iii) the phase velocity v_p.

(iv) wavelength λ.

(v) sending end current I_S.

(vi) receiving end current I_R and its' phase relative to the sending end current.

(vii) reflection coefficient of the line.

(viii) Voltage Standing Wave Ratio (VSWR) of the line.

7.

(a) Draw a schematic diagram of a TV receiver and briefly explain the function of each block.

(b) Explain the principle of Time Division Multiplexing (TDM).

(c) Four telephone channels (each 4 kHz bandwidth) are to be transmitted over a line in such a way that the line bandwidth is minimally utilized.

Describe how this is done using FDM. Give the values of the sub-carriers used in the modulation process.

8.

Briefly explain the following:

(a) Group velocity of an e.m. wave.

(b) Cross talk in O / W lines.

(c) Time Division Multiplexing (TDM)

(d) Pulse Width Modulation (PWM)

(e) Use of Eye patterns in PCM