Q2 (a) Classify the various types of network elements and explain each of them with examples.

Answer

The various types of network elements

1. Active & Passive
2. Unilateral & Bilateral
3. Linear & Non-linear
4. Lumped & Distributed

1. Active elements: - The elements which are capable of amplifying & processing an electrical signal are called active elements.

Ex: - (i) Voltage source & current source
(ii) Vacuum tubes
(iii) Transistors
(iv) Diodes etc

Passive elements: - The elements which are not capable of amplifying & processing an electrical signal are called passive elements.

Ex: - (i) Resistors
(ii) Inductors
(iii) Capacitors

(ii) Unilateral & Bilateral :- Unilateral elements are those which transmit widely unequally in the two directions ,where as Bilateral elements are those which transmit equally well in either direction.

Ex: - Elements made of high conductivity materials are in general, bilateral and vacuum tubes.

Crystal Rectifiers, metal rectifiers are unilateral elements.

(iii) Linear and Non-linear elements: - A linear elements is one which is governed by a linear differential equation for all values of applied stimulus. Failing this, The elements is said to be Non-linear.

Ex: - Amplifier is a linear element
Divide is a Non-linear elements

(iv) Lumped and Distributed elements :physically separate elements such as resistor's capacitor & and inductors are referred to as lumped elements & on the other hand, network elements which one inseparable for analytical purpose are called distributed resistors , capacitance and inductance along its length.

Q2 (b) To a 2μF condenser is applied a voltage v(t) as shown in Fig.1. Find:

(i) the current during time t = 0 to t = 1 second.
(ii) charge accumulated across the condenser at t = 1 second.
(iii) power in the condenser at t = 1 second
(iv) energy stored in the condenser at t = 1 second.

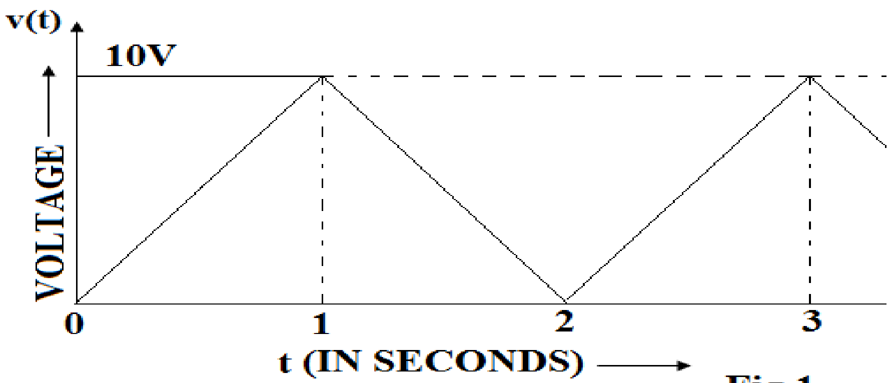


Fig.1

Answer

(i) Current I=dq/dt =d/dt(cv)=c dv/dt

During time t=0 to t=1 second

Dv/dt=10volt/1 sec =10 volts/sec.

Hence I =c dv/dt = $2*10^{-6}*10$= 20MA

(ii) At t=1 second, v=10 volts

Hence q = cv= $2*10^{-6}*10$

Or

$Q=2*10^{-5}$ coulomb

(iii) Power =V*t= v dv/dt

=v d/dt(cv)=vc dv/dt

D t t=1
Dv/dt =10 volts/sec. And

V=10 volts.

.:. Hence power =$10*2*10^{-5}$

P= 2*10^{-4} Watts

(iv) Energy stored

$$=> \int Pdt = \int vc\frac{dv}{dt}.dt$$

$$=> \int vc\,dv = c\int v\,\mathrm{dv} = \frac{1}{2}cv^2$$

$$=> At\ \mathrm{t} = 1\ \ \mathrm{second},$$

=

$$=> \mathrm{energy} = \frac{1}{2}\times 2\times 10^{-6}\times(10)^2$$

$$=> Or\quad \mathrm{Energy} = 10^{-4}\quad \mathrm{Joule's}$$

Q3 (a) Discuss the advantages of Laplace Transform method over classical method?

Answer

Advantages of Laplace Transform method classical method:-

(i) Solution of differential equation is systematic and routine.
(ii) This method gives the total solution i.e., The complementary function and particular solution in one operation.
(iii) Initial conditions are automatically specified in the transformed equation.
(iv) Initial conditions are incorporated into the problem as one of the step rather then as the last step.
(v) The time involved in solving differential equation is much less.
(vi) Laplace transform also provides the direct solution of non- homogeneous differential equations :-

Q3 (b) Find Laplace Transform of:
(i) Unit Impulse function (ii) Unit ramp function

Answer

Laplace Transform of Unit Impulse Function:-
The unit impulse function is given by the eg

S(t)= $\lim \nabla t \to 0 \ \frac{u(t)-u(t-\nabla t)}{\nabla t}$, Which is obviously a derivative of unit stop function ,that is

S(t)= $\frac{d}{dt}[u(t)]$

S(t) has the value zero for t>0 and ∞ at t=0,

However, infinity value at t=0 is unrealistic. Let us, now interduce, a new function as,

G'(t) =

$$\frac{d}{dt}(g(t)) = ae^{-at}$$

$$and \int_0^\infty g'(t)dt = \int_0^\infty ae^{-at} = 1$$

If we now apply Laplace Transform directly, we get

$$=> f(s) = L\,S(t) = \lim L\,g'(t)$$

$$=> \lim a - \infty L ae^{-at}$$

$$=> f(s) = \lim a - \infty \frac{a}{s+a} = 1$$

This shows that Laplace transform of an unit imlulse function is UNITY.

Q3 (c) Find the convolution integral when $f_1(t) = e^{-at}u(t)$ and $f_2(t) = t\,u(t)$, using Laplace transform.

Answer

Finding of Convolution Integral for

$f_1(t) = e^{-at}$ and $f_2(t) = t$.

Convolution Integral is given by.

$$=> f_1(t)\times f_2(t)=\int_0^t f_1(t-T)\, f_2(T)\,dT$$

$$=> \int_0^t e^{-a(t-T)}\,T\,dT$$

$$=> e^{-at}\int Te^{aT}aT$$

$$=> e^{-at}\int \frac{Te^{aT}}{a}-\left[\frac{1.e^{aT}}{a}.dT\right]_0^t$$

$$=> e^{-at}\left[\frac{Te^{at}}{a}-\frac{e^{at}}{a^2}\right]_0^t$$

$$=> e^{-at}\left[\frac{te^{at}}{a}-\frac{e^{at}}{a^2}+\frac{1}{a^2}\right]$$

$$=> \therefore\ f_1(t)\times f_2(t)=\frac{e^{-at}}{a^2}\left[ate^{at}-e^{at}+1\right]$$

Q4 (a) Apply Routh-Hurwitz criterion to check the stability of system whose characteristic equation is given by $s^5+s^4+4s^3+24s^2+3s+63=0$**. Also determine the number of roots**

(i) with positive real parts
(ii) with zero real parts
(iii) with negative real parts

Answer The Routh Array for the given polynomial

$5^5+5^4+4s^3+24s^2+3s+63=10$ is as below.

s^5	1	4	3
s^4	1	24	63
s^3	-20	-60	
s^2	21	63	
s^1	0	0	
s^0	?		

In this case, all the elements in the fifth row have become zero and the array cannot be completed. To proceed further, we equate the given polynomial to the product of two polynomials Q_1 (5) is obtained from the fourth row of the above array.

Thus, $Q_1(s) = 21s^2 + 63 = 21(s^2+3)$
Hence $Q2(s) = Q(s)/Q_1(s)$

$= 5^5+5^4+4s^3+24s^2+3s+63/21(s^2+3)$
$= 1/21\,[s^{3+}\,s^2+s+21]$

Thus the given equation reduces to the following form :(s^2+3) ($s3^+\,s^2+s+21$) =0.
The roots of equation $s^2+3=0$ are $s\ \pm j\sqrt{3}$ these two roots have Zero real parts.
The nature of the roots of equation $s^{3+}\,s^2+s+21=0$ may be found by forming the Ruth Array for this polynomial as given below;-

s^3	-1	1
s^2	1	21
s^1	20	
s^0		21

We find this array that there are two changes in sighn of the elements in the first column. Hence there are two roots. Which have positive real parts and the remaining two roots of the above equation have negative real parts.
Therefore Out of six roots of the given equation, two have positive real parts, two have Zero real parts and the remaining two have negative real parts.

Q4 (b) Obtain the ABCD Parameters of the network shown in Fig.2 and verify that the circuit is symmetrical and reciprocal

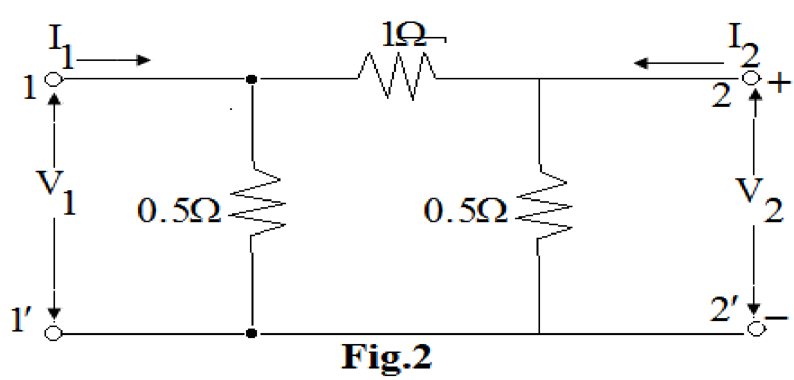
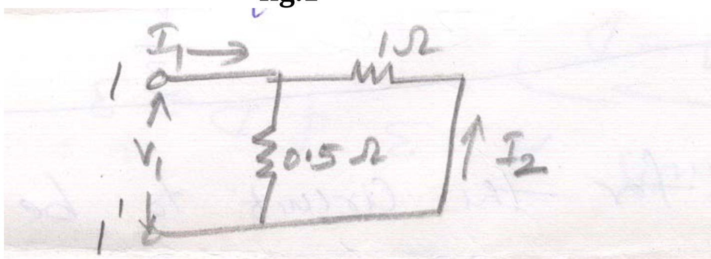


Fig.2

Answer

Obtaining of Transmission Parameters for the given n/w; ---On short circuiting port2, in given n/w the circuit reduce to the form as shown in

fig.1



Here V_1=-I_2 (1Ω) =-I_2

Hence

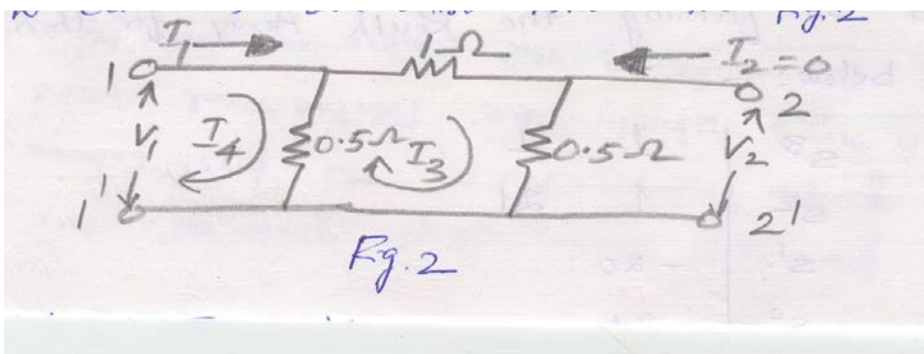
B=-- V_1/ I_2/ V_2=0 =1Ω

Also I_2 = $V_{1/0.5}$ + V_1 /1=3 V_1 =-3 I_2

Hence

D=-I_1/ I_2 /V_2

With port 2 open circuited, we get I2 =0 and mesh currents and also shown in fig2



Then I4= V_1/0.5 =2 V_1

= I_3 = V_1/1.5=2 V_1 /3

I_1=I_3+ I_4=2 V_1 (1+1/3) =8 V_1 /3

V_2= I_3 0.5=0.5*2 V_1 /3 = V_1 /3

Hence

A= V_1/ V_2/ I_2 =0 =3

C= I_2/ V_2/ I_2 =0 = 8 V_1 /3/ V_1 /3=8 Ω

The condition for the circuit to be symmetry is

A=D

From the result A=3 & D=3

.:. A=D …… Therefore the given circuit is symmetry.

Q5 (a) The voltage applied to a series RLC circuit is 0.85V. The Q of the inductor coil is 50 and the value of the capacitor is 320 pF. The resonant frequency of the circuit is 175 KHz. Find:
(i) the value of inductance
(ii) the value of resistance
(iii) the voltage across capacitor

Answer

It is given that

$V=0.85V_1$, Q=50
$C=320*10^{-12}$ and $F0 = 175*10^3$

Putting these values in the formula for resonant frequency, we get

(i) $f_0 = 1/\pi\sqrt{LC}$ or $f_0^2 = 1/4\pi^2 LC$

or $L = 1/\pi^2 f_0^2 c = 1/4*(3.14)^2 (\mathbf{175}*10^3)^2*320*10^{-2}$

$L = 10^5/3\,764*10^4 = 263$ mh

(ii) Q = WoL/R or Resistance R= WoL/Q

(or) $R = WoL/Q = 2\pi*175*10^3 * 263 * 10^3/50$ (:.$Wo = 2\pi f_0$)

R=576 k Ω

(iii) Voltage across capacitor Vc = QV

Vc =50*0.85V =42.5V

Q5 (b) Compare the frequency response curve of an amplifier with single and double tuned circuits and discuss the use of double tuned circuits in Radio Receivers.

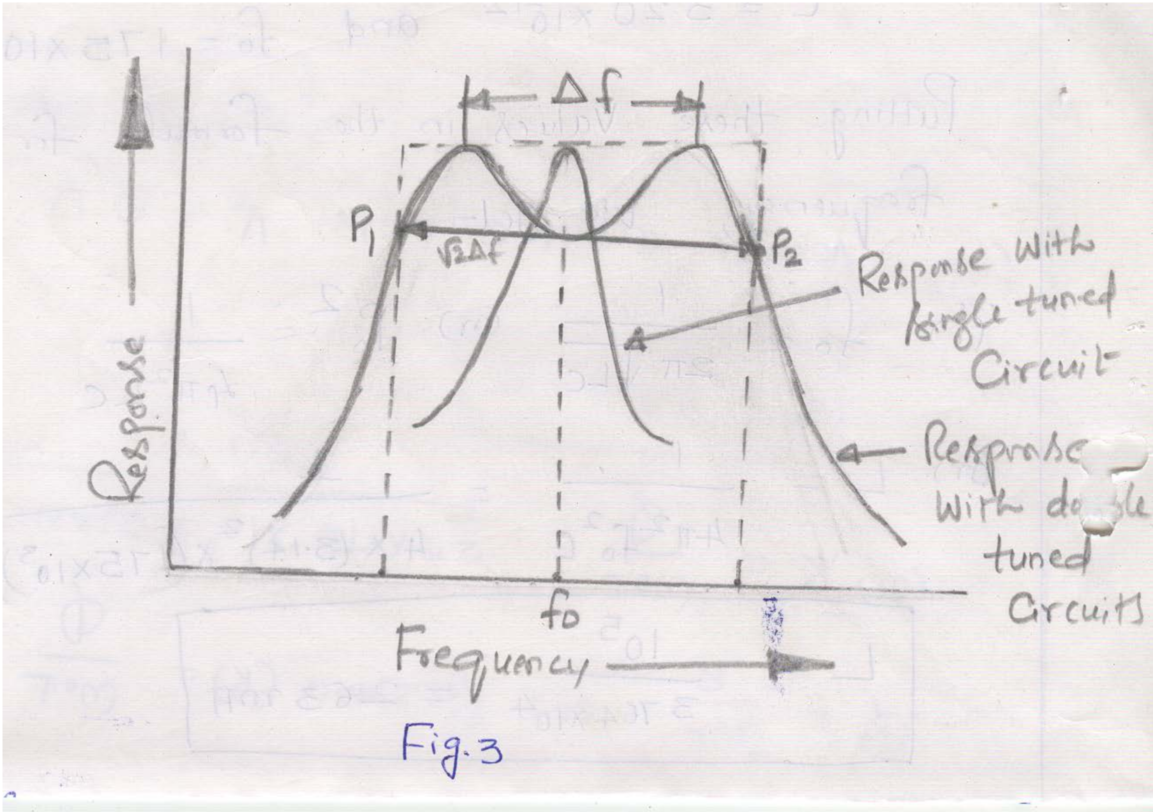


Fig.3 Shows response curves of an amplifier with single tuned and double tuned circuits with critical coupling

(i) In the case of double tuned circuit the pass band with almost constant response may be taken as bandwidth (wider) between point's p_1 and p_2 on the curve having response equals to that at the center frequency and this bandwidth equals to $\sqrt{2}\,\Delta f$, where Δf the bandwidth between is cannot peak, where for single tuned circuit. There is only one peak with narrower band width.

(ii) The slope of the slides of the response curve depends on the Q-factor of the circuit Higher the Q_1 steepen the curve. Hence highQ circuit should be used for better selectively. But as is evident from fig.3, the sides of the response curves of single tuned circuit remain less steep; however large Q may be chosen But Double tuned circuits have to be used for good selectivity.

<u>Use of Double Tuned Circuits in Radio Receivers </u>:- A broadcast receiver in idea condition is expected to have uniform response to amplitude modulated signal occupying a total bandwidth of 10KHZ centered about the carrier frequency single tuned circuit used as the load impedance in an amplifier fails to meet the requirement of bandwidth of 10KHZ by the following two drawbacks :-

(i) Its [single tuned circuit] response is not flat topped and

(ii) Its response falls very slowly with critical coupling are popularly used as load impedance in I.F (Intermediate frequency).

A plifier stage in a super heterodyne receiver. The double tuned circuit meets the ideal condition regarding bandwidth to a very large extent. The critically double tunned circuit has an almost flat topped response with very small double humps. A flat topped response permits equal reproduction of all audio modulating frequencies. i.e., permits high fidelity. Further the response drops rapidly with frequency at the edges of the 10KHZ pass band, i.e. the circuit has high selectively.

Q6 (a) State Thevenin's Theorem and find the current flowing through the load resistor 22Ω in the circuit shown in Fig.3 by applying Thevenin's theorem.

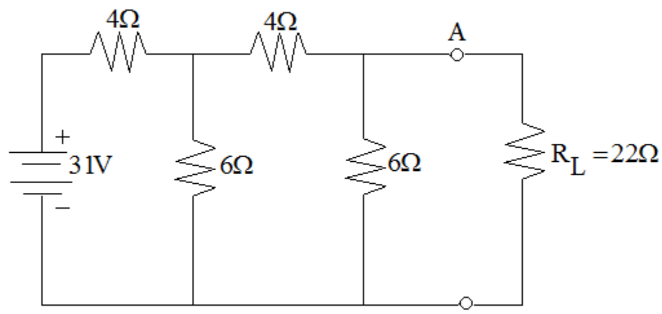


Fig.3

Answer

Thevenins Theorem; - It status that "any two "network consisting of linear impedances and generators maybe replace by an e.m.f is the acting in series with an impedance. The e.m.f is the open circuit voltage at the terminals, when all the generators in the network have been replacing by impedances equal to their internal impedances"

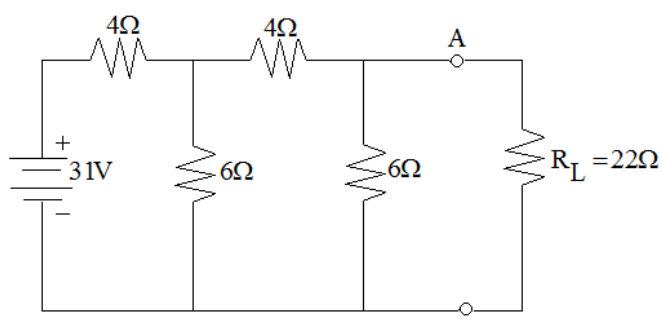


Fig.3

In the given citcuit, of fig 4, the point A is at same potential at points C and is equal to drop across 6Ω resistor in CD path. The circuit of Fig 4 can be redraw by opening the load resistors of $R_2=22\Omega$ shown in fig.5 for finding of Voc;-

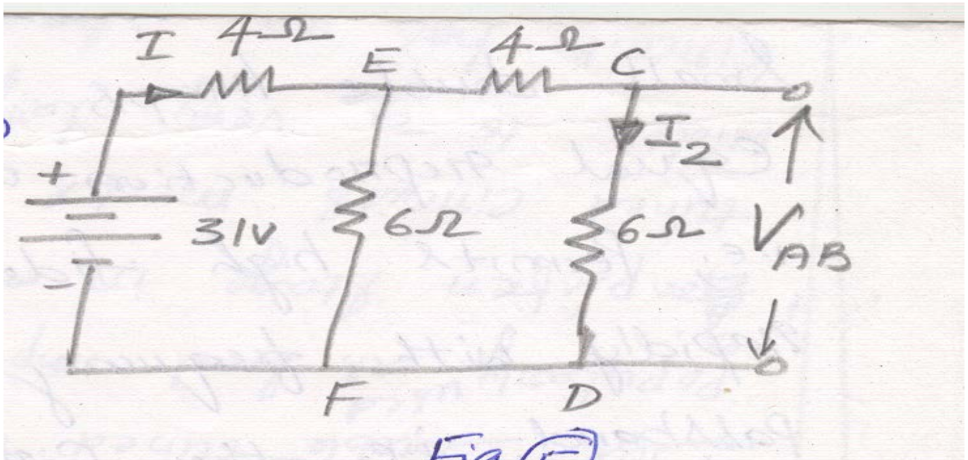


Fig 5

From fig.5 the main current from 31v battery is

I= 31/4+6*(6+4)/6+6+4 =4 Amp

Therefore, Voc =I_{2*} 6 Ω = I*6/6+4+6*6=4*5/16*6=9v

Hence

Voc =9Volts

Finding of Theveninis Resistance RAB:-

Since the internal resistance of 31V battery has not been given , it will be assumed to be Zero resistance . Hence as shown in fig 6. , battery can be replace by short circuit to calculated the theveninis equivalent resistance RAB looking back to the terminal A and B

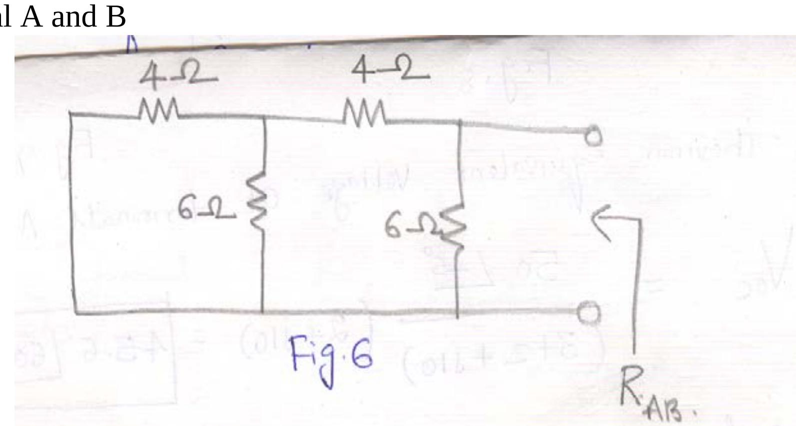


Fig.6

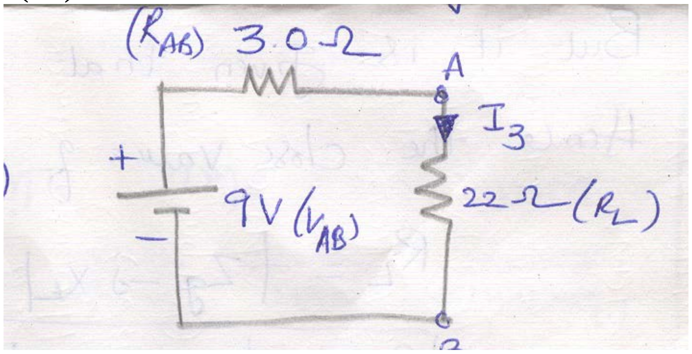
.:. RAB = [[(4||6) +4] ||6]

= [4*6/4*6+4]*6 = 384/124=96/31=3.01 Ω

Hence

RAB =3.01 Ω

Now, Theveninins equivalent is shown in fig.7 therefore, the current flowing through the load resistors (R_2) 22 Ω is



$I_L = V_{AB}$ /RAB + $R_{2=}$ 9/3.01+22 = 0.359 Amp

Fig .7

Or

I_2= 0.359 Amp

Or

359mA

Q6 (b) In the network shown in Fig.4, the load connected across terminals AB consists of a variable resistance, R_L and a capacitive reactance X_L which may vary from 2Ω to 8Ω. Determine:

(i) The value of R_L and X_L which result in maximum power transfer

(ii) the maximum power delivered to the load.

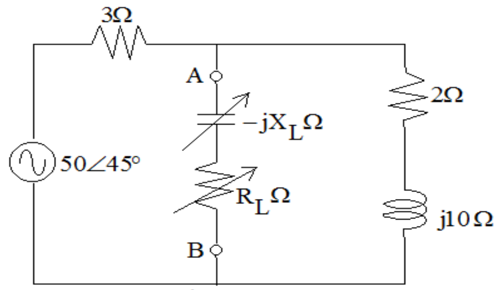
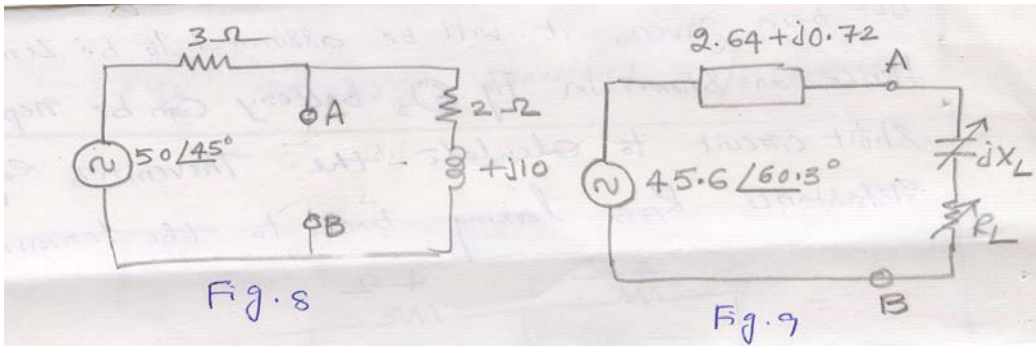


Fig.4

Answer



The Thevenin equivalent voltage at terminals AB in fig…..

Voc =50L45^0/(3+2+i10)(2++j10)= 45.6L60.3^0

Impededasce ZAB across AB with load removed is given by,

ZAB = 3(2+j10)/3+2+j10 = 2.64 + j0.72

Therefore, the equivalent circuit of fig.8 can be drawn as shown in fig.9

Maximum Power Transfer will take place, when

Z_L= Zg= 2.64+j0.72

But it is given that X_L is adjustable from 2Ω **to** 8Ω. Hence the close value of X_L is 2Ω and

R_L=| Zg –j*xL|=|2.64+j0.72-j2|

$R_{L=}$|2.64-j 1-28| =2.93 Ω

Now Total Impedance,

Z=Z_{AB}+ Z_c =2.64+j0.72+2.93-j2

Z=5.57-j1.28=5.70L-13^0

Therefore, that current I flowing in the circuit shown by fig.9 is given by,

I=Voc/Z =45.5L60.3^0 /5.70L-13^0 =8.0 L73-3^0

Now the Maximum power 'P 'delivered to the load is given by,

P=I^2R_L = $(8.0)^2$*2.93=187.5 watts

Q7 (a) The primary constants of a transmission line per loop kilometre are $R = 196\Omega, C = 0.09\mu F, L = 0.71mH$ and leakage conductance is negligible. Calculate the secondary constants at a frequency of $\left(\frac{5,000}{2\pi}\right)Hz$.

Answer

Finding of Secondary constants of a Transmission line:-

Given that $R = 196\Omega, C = 0.09\mu F, L = 0.71mH$ and

$F = \left(\frac{5,000}{2\pi}\right)Hz$

Now, we know that w= 2π f

(or) w = $2\pi \times \left(\frac{5,000}{2\pi}\right) = 5 \times 10^3$ =5KHZ (.:. f = $\left(\frac{5,000}{2\pi}\right)Hz$)

Series Impedance Z=R+jWL

= 196 +j $5 \times 10^3 \times 0.71 \times 10^{-3}$

= 196 + j35.5 = 199.2 L10.5^o

Z = 199.2 L10.5^o

Similarly, shunt Admittance,

Y= G+jwc = $0+j5 \times 10^3 \times 0.09 \times 10^{-6}$

Y=0.45×10^{-3} L90^o

Second Constants:-

(i) Characteristic Impedance(Z^o)is given by

$$\Rightarrow z_o = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{199.2L10.5^o}{0.45\times10^{-3}L90^o}} = \sqrt{\frac{199.2}{0.45\times10^{-3}}}L\frac{10.5^o-90^o}{2}$$

$\Rightarrow 10.4L-39.75^o\Omega$

Z_0=10.4 L-39.75^o Ω

(ii) Propagation constant (P) is given by

$$=> P\sqrt{Z \times Y} = \sqrt{199.2L10.5^0 \times 0.45 \times 10^{-13} L90^0}$$

$$=> 2.999 \times 10^{-4} L50.25^0$$

$$=> p = 0.299L50.25$$

Q7 (b) An underground cable has $Z_o = 400\angle -40^\circ, \alpha = 0.079 \text{neper/Km}$ and $\beta = 0.084$ radians/Km. If the receiving end current $I_R = 0.005\angle -190^\circ$ and the line is terminated by an impedance $Z_R = 600\angle -20^\circ$, calculate:

(i) The reflection coefficient

(ii)Voltage in the line at a distance of 10 Km from the receiving end

(iii) Current in the line at a distance of 10 Km from the receiving end

Answer

Reflection Coefficient is given by.

$$K => \frac{Zr - Zo}{Z_R + Zo}$$

Given that Zo=400L-40^o and Z_R=600L-20^o

Now, Zo=400L-40^o 306.4-j257.1 and Z_R=600L-20^o=563.8-j205.2

Hence K =

$$=> \frac{(563.8 - j205.2) - (306.4 - j257.1)}{(563.8 - j205.2) + (306.4 - j257.1)}$$

$$=> \frac{257.4 + j51.9}{870.2 - j462.0} = \frac{262.6L11.4}{986L - 28} = 0.267L39.4$$

Calculation of Voltage and current in the time :

$E^{-ry} = E^{-Ly} E^{-jBy} = E^{-0.79}$ L 0.84*180/ π

E^{ry}=2.2034L-48.1^o

(ii) Voltage in the line : Voltage in the line is given by

$$Ex => \frac{E_R(Z_{R+}Z_o)}{2Z_R}(E^{ry} + KE^{-ry})$$

$$=> \frac{0.005L190^0 \times 985L - 28^0}{2 \times 600L - 28^0}.[2.2034[48.1^0 + 0.267[39.4^0 \times 0.4538[-48.1^0]$$

$$=> E_x = 2.462L - 218^0[1.47 + j1.64 + 0.1194 - j0.0183]$$

$$=> 2.462L - 218^0 \times 2.27L45.6^0$$

OR

$$=> E_x = 5.6[-172.4^0 volts$$

(iii) Current in the line: - Current in the line is given by

$$Ix => \frac{I_R(Z_{R+}Z_o)}{2Z_o}(E^{ry} - KE^{-ry})$$

$$=> \frac{0.005L190^0 \times 985L - 28^0}{2 \times 400L - 40^0}.[2.2034[48.1^0 + 2.67[39.4^0 \times 0.4538[-48.1^0]$$

Or

$$=> Ix = 0.00616[-178^0[1.3506 - j1.6583]$$

$$=> Ix = 0.00616[-178^0 \times 2.14[50.9^0$$

$$=> \therefore Ix = 0.0132L - 127.1^0 \ Amp$$

Q8 (a) What is meant by quarter wave transformer? Why is it also called as impedance inverter? Discuss its applications in transmission lines

Answer

Quarter Wave Transformer: A quarter (λ /4) Wave line can be considered as a impedance transformer to match a load impedance Z_R to a source impedance Z_s by pro selection of the value of Ro so as to satisfy the equation

$$Zi(\lambda/4) = R_0^2 / Z_R$$

Is called Quarter Wave transformer

The matching selection of line should be properly Designed so that its characteristic resistance Ro satisfy the eq i.e Ro is given by

$$R_0 = |\sqrt{Z_S Z_R}|$$

Impedance Inverter: - Quarter Wave Transformer is also called as impedance at the Invemter, because it transformer a low impedance at the load sides into a high impedance at the generator side or vice versa.

<u>Applications</u>;-

(i) impedance Transformer :- A quarter wave line having Zero impedance (or) short circuit at one end transforms it into infinite impedance (or) open circuit at the other end

Similarly an open circuited quarter – wave line transformer an open circuit termination into a low impedance or a short circuit at the sending end terminals.

(2) Quarter wave line as a Impedance matching device: Quarter wave line is used as a matching section between a transmission line and a resistive load of an antenna. The quarter –wave matching line must be designed to have characteristic impedance Ro' such that the antenna resistance RA is transformed into a value equal to the characteristic impedance R_0^1 of the matching section is given by

$$R_0 = \sqrt{R_0 R_A}$$

Such a resistive matching also fulfils the condition of Maximum power .Transfer

(3) Quarter Wave line as a Impedance matching device when the load is not a pure resistance :-

A Quarter wave line may also be used an impedance matching device, when the load impedance is not a pure resistance. In this case, matching section should be connected at a voltage – maximum points where the transmission line has resistive input impedance given by Ro/S .Thus matching section should have characteristic resistance given by

$$R_0^1 = \sqrt{R_0 \frac{R_0}{S}} = R_0\sqrt{\frac{1}{S}}$$

(4) Quarter Wave line as INSULATOR :A short circuit quarter wave line can also be used as an insulator support an open wire line as shown in fig .10

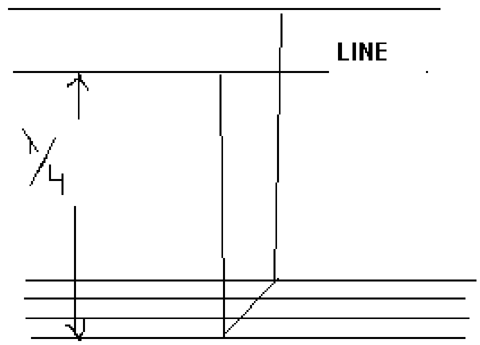


FIG .10

This is possible ,since the c/p impedance of the quarter wave have by the main transmission line is infinite .Ω very high at the frequency which make & the line of length .Ω/4 .At other frequencies , a small amount of less may take However , this configuration maybe conveniently used for a single frequency .Ω for a narrow band of frequencies . Such .Ω/4 lines are called copper insulators.

Q8 (b) The VSWR measured on UHF transmission line working at a frequency of 300 MHz is found to be 2. If the distance between load and voltage minimum is 0.8 meter, calculate the value of load impedance.

Answer

Finding of Load Impedance

It is given that f=300MHZ

Therefore, λ =1 meter [$\therefore$ = c/f = 3 $\times 10^8$ m/se/3.Ω m2

=1m

s=2

Ymin = 0.8 meter

Here, the value of characterstic impedance is not given. So, we will calculated normalized load impedance Zn, which is the ratio of Z_R to Zo

Thus, Zn= Z_R/Zo

the relation between reflection coefficient and VSWR is given by

|K| = s-1/s+1 = 2-1/2+1 = 1/3 or 0.33

Angle of reflection coefficient is given by

$$.2\beta\frac{1}{\min}-\phi=\pi$$

$$2\times\frac{2\pi}{1}\times 0.8-\phi=\pi$$

$$3.2\pi-\pi=\phi$$

$$therefore, \phi = 2.2\pi = 396(\Omega)(Apprn)$$

Now the reflection coefficient is given by

$$.k = \frac{Z_R - Z_0}{Z_R + Z_0}$$

$$|k| e^{j\phi} = \frac{\frac{Z_R}{Z_o} - 1}{\frac{Z_R}{Z_o} + 1}$$

$$\frac{1}{3} e^{j360} = \frac{Z_r - 1}{Z_r + 1}$$

$$\frac{1}{3}(Cos360 + j\sin 360) = \frac{Z_r - 1}{Z_r + 1}$$

$$0.2677 + j0.1959 = \frac{Z_r - 1}{Z_r + 1}$$

$$Z_r = \frac{1 + 2677 + j0.1959}{1 - 0.2677 - j0.1959}$$

$$= \frac{129\angle 8.9}{0.76\angle 18.3}(Approx) = 1.7\angle -6.4^o$$

$$Therefore, Z_r = 1.7\angle -6.4^o$$

Q9 (a) Design an m-derived T-section low pass filter having cut-off frequency $f_c = 1000\text{Hz}$, **design impedance** $R_K = 600\Omega$ **and frequency of infinite attenuation** $f_\infty = 1050\text{Hz}$ **.**

Answer

Designing of M-derived T-section Low Pass Filter:

Given that $R_K = 600\Omega$, $fc = 1000HZ$ & $f_\infty = 1050HZ$

Let us first design Low pass prototype filter , and the induction is given by the equation

$$L = \frac{R/c}{\pi fc} = \frac{600}{3.14 \times 1000} = 191.08mh$$

$$=> L = 191.08mh$$

The capacitance is given by yhe equation

$$c = \frac{1}{\pi R_K f_c} = \frac{1}{3.14 \times 600 \times 1000} = 0.53lif$$

$$=> c = 0.53\mu f$$

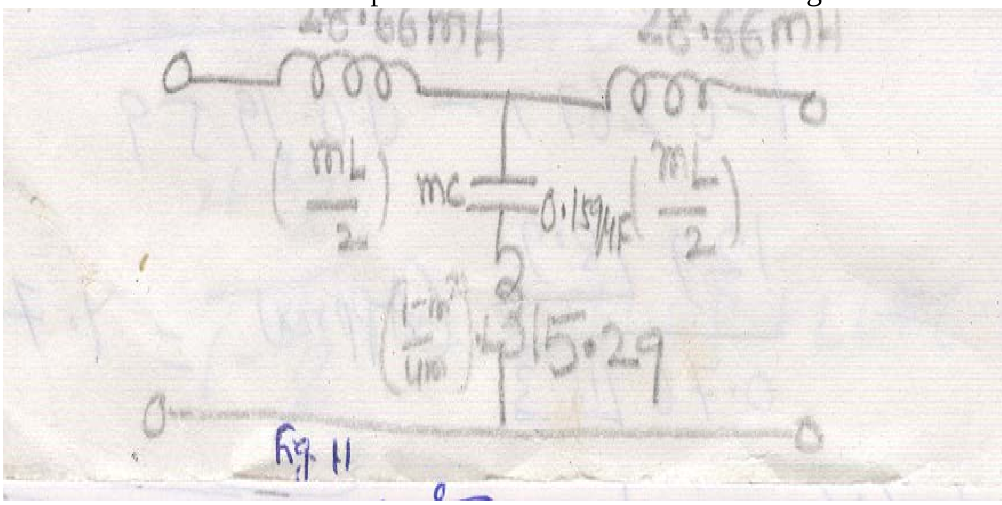
In order to obtain m-derived, we find out the value of m & is given by

$$\frac{ml}{2} = \frac{0.3 \times 191.08}{2} = 28.66mh$$

$$mc = 0.3 \times 0.53 = 0.159\mu c$$

$$and\, \frac{1-m^2}{4m}.L = \frac{1.09}{1.2} \times 191.08 = 15.29mh$$

The derived m-derived Low pass T-section filter is shown in fig.11



Q9 (b) Write short notes on:

(i) Asymmetrical T-attenuator
(ii) Asymmetrical L-attenuator

Answer

Asymmetrical Attenuator

Asymmetrical Attenuator are used when the attenuator is required to work between two unequal impedance. These are designed so that these two unequal impedance form Image Impedance.

Asymmetrical T-attenuator

This attenuator is very widely used in communication circuit .fig12 gives the circuit of Asymmetrical-T attenuator and it is terminated in its images constant Qi of this attenuator is give by

$$e^{Q_0} = \sqrt{\frac{V_s.I_s}{V_{R.}I_R}}$$

$$where Q_i = A_i + jB_i$$

where A_i is the attenuation & B_i is the phase angle

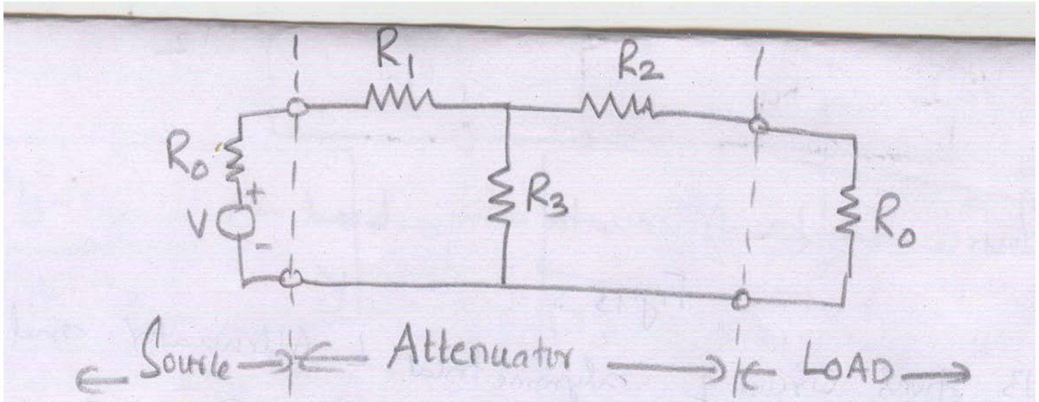


Fig.12

Now since the attenuator is formed of resistors only, V_s and V_R in phase with Is & I_R. Hence Bi=0 & Qi=Ai Nepers
The elements of asymmetrical T-network are
Bi

$$R_1 = \frac{R_{i1}}{\tanh Q_i} - \frac{\sqrt{R_{i1}.R_{i2}}}{\sinh Q_i}$$

$$R_2 = \frac{R_{i2}}{\tanh Q_i} - \frac{\sqrt{R_{i1}.R_{i2}}}{\sinh Q_i}$$

$$R_3 = \frac{\sqrt{R_{i1}.R_{i2}}}{\sinh Q}$$

$=$

<u>Asymmetrical L-attenuator:-</u>

This is the simplest type attenuator using only two resistors. Further, since it offers low attenuation, it maybe used as impedance matching circuit between two unequal impedance equal to the image impedance of the attenuators

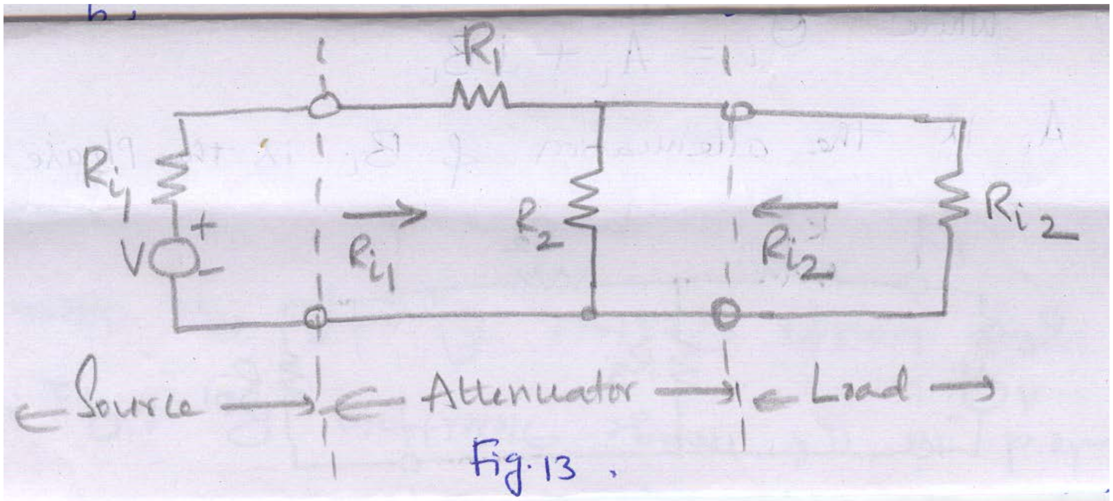


Fig.13 gives circuits of asymmetrical L-Attenuator and it is terminated in its images impedance R_{i1} & R_{i2}

The design equations are:

$$R_1 = \frac{R_{i1}.R_{i2}\sqrt{R_{i1}-R_{i2}}}{\sqrt{R_{i1}.R_{i2}^2}} \, or R_1 = \sqrt{R_{i1}(R_{i1}-R_{i2})}$$

and

$$R_2 = \sqrt{\frac{R_{i1}-R_{i2}^2}{R_{i1}-R_{i2}^2}}$$

Text Books

1. Network Analysis; G. K. Mittal; 14th Edition (2007) Khanna Publications; New Delhi

2. Transmission Lines and Networks; Umesh Sinha, 8th Edition (2003); Satya Prakashan,Incorporating Tech India Publications, New Delhi