Gate Problems on Circuit Analysis

Abstract—This problem set has questions related to RLC circuits taken from GATE papers over the last twenty years. Teachers can use the problem set for course tutorials.

1) In a series RLC high Q circuit, the current peaks at a frequency
   a) Equal to the resonant frequency.
   b) Greater than the resonant frequency.
   c) Less than the resonant frequency.
   d) None of the above.

2) The network shown in figure 1 is initially under steady state condition with the switch in position 1. The switch is moved from position 1 to position 2 at $t \neq 0$. Calculate the current $i(t)$ through $R_1$ after switching.

3) For the series R-L circuit of figure(a)2, the partial fissure diagram at a certain frequency is shown in figure(b). The operating frequency of the circuit is:
   a) Equal to the resonance frequency.
   b) Less than the resonance frequency.
   c) Greater than resonance frequency.
   d) Not zero.

4) For the compensated attenuator of figure 3, the impulse response under the condition $R_1C_1 = R_2C_2$ is:

   a) $\frac{R_2}{R_1 + R_2}[1 - e^{-\frac{R_1}{R_2}t}]u(t)$
   b) $\frac{R_2}{R_1 + R_2}\delta(t)$
   c) $\frac{R_2}{R_1 + R_2}u(t)$
   d) $\frac{R_2}{R_1 + R_2}1 - e^{-\frac{R_1}{R_2}t}u(t)$

5) Of the four networks $N_1, N_2, N_3$ and $N_4$ of figure 4, the networks having identical driving point functions are
   a) $N_1 and N_1$
   b) $N_2 and N_4$
   c) $N_1 and N_3$
   d) $N_1 and N_4$

6) In the series circuit shown in figure 5 for series
resonance, the value of the coupling coefficient K will be

a) 0.25  b) 0.5  c) 0.999  d) 1.0

7) In the circuit of figure 6, when switch S1 is closed, the ideal ammeter M1 reads 5A. What will be ideal voltmeter M2 read when S1 is kept open? (The value of E is not specified).

8) In figure 7 A1, A2 and A3 are ideal ammeters? If A1 reads 5A, A2 reads 12A, then A3 should read.

9) Find the Y-parameters (short circuit admittance parameters) for the network shown in figure 8.

10) The voltages Vc1, Vc2 and Vc3 across the capacitors in the circuit in the given figure 9, under steady state are respectively

a) 80V, 32V, 48V  
 b) 80V, 48V, 32V  
 c) 20V, 8V, 12V  
 d) 20V, 12V, 8V

11) In the circuit shown in figure 10 is (a)-(c), assuming initial voltage and capacitors and currents through the inductors to be zero at the time of switching (t=0), then at anytime $t > 0$

a) Current increases monotonically with time
b) Current decreases monotonically with time

c) Current remains constant at V/R

d) Current first increases then decreases

e) No current can ever flow

12) The current $i_4$ in the circuit of the figure 11 is equal to

a) 12A  b) -12A  c) 4A  d) None of these

13) The voltage $V$ in the figure 12 is equal to

a) 3V  b) -3V  c) 5V  d) None of these

14) The voltage $V$ in the figure 13 is always equal to

15) The voltage $V$ in the figure 14 is

a) 10V  c) 5V  b) 15V  d) None of these

16) In the circuit of the figure 15 is the energy absorbed by the 4Ω resistor in the time interval $(0, \infty)$ is

Fig. 10

Fig. 12

Fig. 13

Fig. 14

Fig. 15
a) 36 Joules  

b) 16 Joules  

c) 256 Joules  

d) None of these

17) In the circuit of the figure 16 is the equivalent impedance seen across terminals a,b is 

a) \((\frac{16}{3})\Omega\)

b) \((\frac{8}{3})\Omega\)

c) \((\frac{8}{3} + 12j)\Omega\)

d) None of above

![Fig. 16](image)

A communication channel has first order low pass transfer function. The channel is used to transmit pulses at a symbol rate greater than the half-power frequency of the low pass function. Which of the network shown in the figure 17 is can be used to equalise the received pulses?

![Fig. 17](image)

Fig. 17

18) In the circuit of the figure 16 is the equivalent impedance seen across terminals a,b is 

a) \((\frac{16}{3})\Omega\)

b) \((\frac{8}{3})\Omega\)

c) \((\frac{8}{3} + 12j)\Omega\)

d) None of above

![Fig. 18](image)

Fig. 18

19) In the circuit of the figure 18 is R=100Ω, L=20 nH and C=32pF. The circuit is maintained at a temperature of 300k. Derive and plot the power spectral density of the voltage \(V_0\). Mark all the relevant points on the plot with numerical values. (The Boltzmann constant \(k=1.28 \times 10^{-23} \text{J/k}\))

![Fig. 19](image)

Fig. 19

20) In the circuit of figure 19 when R=0Ω, the current \(i_k\) equals 10A  

a) Find the value of R for which it absorbs maximum power  

b) Find the value of \(\varepsilon\)  

c) Find \(V_2\) when R=∞ (open circuit)

![Fig. 20](image)

Fig. 20

21) In the circuit of the figure 20 is all currents and voltages are sinusoids of frequency \(\omega\) rad/sec.  
a) Find the impedance to the right of(A,B) at \(\omega=0\) rad/sec and \(\omega=\infty\) rad/sec.  

b) If \(\omega = \omega_0\) rad/sec and \(i_1(t)=I \sin(\omega_0 t)\) then

A, where I is positive \(\omega_0 \neq 0\), \(\omega_0 \neq \infty\) then
find $I_0$ and $i_2(t)$

![Fig. 20]

22) The nodal method of circuit analysis is based on
a) KVL and Ohm’s law
b) kCL and Ohm’s law
c) KCL and KVL
d) KCL,KVL and Ohm’s law

23) Superposition theorem is NOT applicable to networks containing
a) Nonlinear elements
b) Dependent Voltage Sources
c) Dependent current sources
d) transformers

24) The parallel RLC circuit shown in figure.21 is in resonance. In this circuit
a) $|I_R| < 1mA$
    c) $|I_R + I_C| < 1mA$
b) $|I_R + I_L| > 1mA$
    d) $|I_R + I_C| > 1mA$

25) The Voltage across the terminals a and b in figure.22 is
a) 0.5V
b) 3.0V
c) 3.5V
d) 4.0V

![Fig. 21]

![Fig. 22]

26) Determine the frequency of resonance and the resonant impedance of the parallel circuit shown in Figure.23. What happens when $L = CR^2$?

![Fig. 23]

27) The Thevenin equivalent voltage $V_{TH}$ appearing between the terminals A and B of the network shown in Fig.24 is given by
a) j16(3-j4)
b) j16(3+j4)
c) 16(3+j4)
d) 16(3-j4)

![Fig. 24]
28) The value of R (in ohms) required for maximum power transfer in the network shown in Fig. 25 is

a) 2 b) 4 c) 8 d) 10

![Fig. 25](image)

29) A Delta-connected network with its Wye-equivalent is shown in Fig. 26, Fig. 27. The resistance $R_1$, $R_2$, and $R_3$ (in ohms) are respectively

![Fig. 26](image)

![Fig. 27](image)

30) In the circuit of Fig. 28, the switch ‘S’ has remained open for a long time. The switch closes instantaneously at $t=0$

a) Find $V_0$ for $t \leq 0$ and as $t \to \infty$

b) Write an expression for $V_0$ as function of time for $0 \leq t \leq \infty$

c) Evaluate $V_0$ at $t=25 \, \mu$sec

![Fig. 28](image)

31) For the network shown in Fig. 29 evaluate the current $I$ flowing through the 2Ω resistor using superposition theorem.

![Fig. 29](image)

32) In the circuit of Fig. 30 the voltage $v(t)$ is

a) $e^{at} - e^{bt}$

b) $e^{at} + e^{bt}$

c) $ae^{at} - be^{bt}$

d) $ae^{at} + be^{bt}$

![Fig. 30](image)

33) The circuit of figure. 31 represents a

a) low pass filter
d) band reject filter

b) high pass filter
c) band pass filter
34) Use the data of figure 32. The current I in the circuit of figure (b) is
   a) -2A    b) 2A    c) -4A    d) +4A

   ![Figure 32](image1.png)

35) For the circuit in figure 33
   a) Find the Thevenin equivalent of the sub circuit faced by the capacitor across the terminals a,b.
   b) Find $v_c(t), t>0, \text{given } V_c(0)=0$
   c) Find $i(t), t>0$

   ![Figure 33](image2.png)

36) For the circuit in figure 34, which is in steady state.
   a) Find the frequency $\omega_0$ at which the magnitude of the impedance across terminals a,b reaches a maximum.
   b) Find the impedance across a,b at the frequency $\omega_0$.
   c) If $v_s(t)=V \sin(\omega_0 t)$, find $i_L(t), i_R(t)$.

37) For the circuit in figure 35, write the state equations using $v_c$ and $i_L$ as state variables

38) The voltage $e_0$ in figure 36 is
   a) 2V    b) $\frac{4}{3}$V    c) 4V    d) 8V

   ![Figure 36](image3.png)

39) The voltage $e_0$ in figure 37 is
   a) 48V    b) 24V    c) 36V    d) 28V

   ![Figure 37](image4.png)

40) In figure 38, the value of the load resistor R which maximizes the power delivered to it is
   a) 14.14Ω    c) 200Ω
   b) 10Ω    d) 28.28Ω
41) When the angular frequency $\omega$ in Figure 39 is varied from 0 to $\infty$, the locus of the current phasor $I_2$ is given by

$$I_2 = \frac{E_m}{\omega L} e^{j\omega t}$$

42) For the circuit shown in figure 40, determine the phasors $E_2, E_0, I$ and $I_1$

43) The circuit shown in figure 41 is operating in steady-state with switch $S_1$ closed.
   a) Find $i_L(0^+)$
   b) Find $e_1(0^+)$

44) The dependent current source shown in figure 42
   a) delivers 80W
   b) absorbs 80W
   c) delivers 40W
   d) absorbs 40W

45) In figure 43, the switch was closed for a long time before opening at $t=0$. The voltage $V_x$ at $t=0^+$ is
   a) 25V
   b) 50V
   c) -50V
   d) 0V

46) In the network of figure 44, the maximum power is delivered to $R_L$ if its value is
47) The switch in Figure 45 has been in position 1 for a long time and is then moved to position 2 at \( t=0 \).
   a) Determine \( V_c(0^+) \) and \( I_L(0^+) \)
   b) Determine \( \frac{dV_c(t)}{dt} \) at \( t=0^+ \)
   c) Determine \( V_c(t) \) for \( t > 0 \)

48) For the network shown in Figure 46, \( R=1 \) K\( \Omega \), \( L_1 = 2 \) H, \( L_2 = 5 \) H, \( L_3 = 1 \) H, \( L_4 = 4 \) H and \( C=0.2 \mu\)F. The mutual inductances are \( M_{12}=3 \) H and \( M_{34}=2 \) H. Determine
   a) the equivalent inductance for the combination of \( L_3 \) and \( L_4 \).
   b) the equivalent inductance across the points A and B in the network.
   c) the resonant frequency of the network.

49) The minimum number of equations required to analyze the circuit shown in Figure 47
   a) 3
   b) 4
   c) 6
   d) 7

50) A source of angular frequency 1 rad/sec has a source impedance consisting of 1\( \Omega \) resistance in series with 1H inductance. The load that will obtain the maximum power transfer is
   a) 1\( \Omega \) resistance
   b) 1\( \Omega \) resistance in parallel with 1H inductance
   c) 1\( \Omega \) resistance in series with 1F capacitor
d) 1Ω resistance in parallel with 1F capacitor

d) -(0.192+j0.144)

51) A series RLC circuit has a resonance frequency of 1 kHz and a quality factor Q=100. If each R, L and C is doubled from its original value, the new Q of the circuit is

a) 25  b) 50  c) 100  d) 200

52) The differential equation for the current i(t) in the circuit of figure 48 is

a) \(2 \frac{d^2i}{dt^2} + 2 \frac{di}{dt} + i(t) = \sin t\)

b) \(\frac{d^2i}{dt^2} + 2 \frac{di}{dt} + 2i(t) = \cos t\)

c) \(2 \frac{d^2i}{dt^2} + 2 \frac{di}{dt} + i(t) = \cos t\)

d) \(\frac{d^2i}{dt^2} + 2 \frac{di}{dt} + 2i(t) = \sin t\)

53) Twelve 1Ω resistances are used as edges to form a cube. The resistance between two diagonally opposite corners of the cube is

a) \(\frac{5}{6}\)Ω  b) \(\frac{1}{6}\)Ω  c) \(\frac{6}{5}\)Ω  d) \(\frac{3}{2}\)Ω

54) The current flowing through the resistance R in the circuit in figure 49 has the form P cos 4t, where P is

a) (0.18+j0.72)

b) (0.46+j1.90)

c) -(0.18+j1.90)

55) The circuit for Q.55-56 is given in figure 50. For both the questions, assume that the switch S is in position 1 for a long time and thrown to position 2 at t=0. At t=0⁺, the current i₁ is

a) \(-\frac{V}{2R}\)

b) \(-\frac{V}{\pi}\)

d) zero

c) \(-\frac{V}{4R}\)

56) \(I_1(s)\) and \(I_2(s)\) are the Laplace transforms of \(i_1(t)\) and \(i_2(t)\) respectively. The equations for the loop currents \(I_1(s)\) and \(I_2(s)\) for the circuit shown in figure Q.55-56, after the switch is brought from position 1 to position 2 at t=0, are

\[
\begin{bmatrix}
R + L_s + \frac{1}{C_s} & -L_s \\
-L_s & R + \frac{1}{C_s}
\end{bmatrix}
\begin{bmatrix}
I_1(s) \\
I_2(s)
\end{bmatrix} =
\begin{bmatrix}
\frac{V}{s} \\
0
\end{bmatrix}
\]
b) \[
\begin{bmatrix}
R + L_s + \frac{1}{C_s} & -L_s \\
-L_s & R + \frac{1}{C_s}
\end{bmatrix}
\begin{bmatrix}
I_1(s) \\
I_2(s)
\end{bmatrix} =
\begin{bmatrix}
\frac{V}{s} \\
0
\end{bmatrix}
\]

c) \[
\begin{bmatrix}
R + L_s + \frac{1}{C_s} & -L_s \\
-L_s & R + L_s + \frac{1}{C_s}
\end{bmatrix}
\begin{bmatrix}
I_1(s) \\
I_2(s)
\end{bmatrix} =
\begin{bmatrix}
\frac{V}{s} \\
0
\end{bmatrix}
\]

d) \[
\begin{bmatrix}
R + L_s + \frac{1}{C_s} & -L_s \\
-L_s & R + L_s + \frac{1}{C_s}
\end{bmatrix}
\begin{bmatrix}
I_1(s) \\
I_2(s)
\end{bmatrix} =
\begin{bmatrix}
\frac{V}{s} \\
0
\end{bmatrix}
\]

57) An input voltage \(v(t) = 10\sqrt{2} \cos(t+10^\circ) + 10\sqrt{3} \cos(2t+10^\circ)\) V is applied to a series combination of resistance \(R=1\Omega\) and an inductance \(L=1H\). The resulting steady state current \(i(t)\) in ampere is

a) \(10 \cos(t+55^\circ) + 10 \cos(2t+10^\circ + \tan^{-1} 2)\)

b) \(10 \cos(t+55^\circ) + 10 \sqrt{3} \cos(2t + 55^\circ)\)

c) \(10 \cos(t-35^\circ) + 10 \cos(2t+10^\circ - \tan^{-1} 2)\)

d) \(10 \cos(t-35^\circ) + 10 \sqrt{3} \cos(2t - 35^\circ)\)

58) The equivalent inductance measured between the terminals 1 and 2 for the circuit shown in figure 51, is

a) \(L_1 + L_2 + M\)

c) \(L_1 + L_2 + 2M\)

b) \(L_1 + L_2 - M\)

d) \(L_1 + L_2 - 2M\)

59) The circuit shown in figure 52 with \(R=\frac{1}{\sqrt{3}}\) W, \(L=\frac{1}{4}H\), \(C=3F\) has input voltage \(v(t) = \sin(2t)\). The resulting current \(i(t)\) is

60) For the circuit shown in Figure 53, the time constant \(RC=1ms\). The input voltage is \(v_1(t) = \sqrt{2} \sin 10^3 t\). The output voltage \(v_0(t)\) is equal to

a) \(\sin(10^3 t - 45^\circ)\)

c) \(\sin(10^3 t - 53^\circ)\)

b) \(\sin(10^3 t + 45^\circ)\)

d) \(\sin(10^3 t + 53^\circ)\)

61) For the R-L circuit shown in Figure 54, the input voltage \(v_i(t) = u(t)\). The current \(i(t)\) is

62) The circuit shown in Figure 55 has initial current \(i_L(0) = 1A\) through the inductor and an
Fig. 54

initial voltage $V_c(0) = -1V$ across the capacitor. For input $v(t) = u(t)$, the Laplace transform of the current $i(t)$ for $t \geq 0$ is

a) $\frac{s}{s^2 + s + 1}$  
b) $\frac{s+2}{s^2 + s + 1}$  
c) $\frac{s-2}{s^2 + s + 1}$  
d) $\frac{s-2}{s^2 + s - 1}$

Fig. 55

63) For the circuit shown in Figure.56, the initial conditions are zero. Its transfer function $H(s) = \frac{V_c(s)}{V_1(s)}$ is

a) $\frac{1}{s^2 + 10^6 s + 10^6}$  
b) $\frac{10^6}{s^2 + 10^6 s + 10^6}$  
c) $\frac{10^3}{s^2 + 10^6 s + 10^6}$  
d) $\frac{10^6}{s^2 + 10^6 s + 10^6}$

Fig. 56

64) The condition on R, L, and C such that the step response $y(t)$ in figure.57 has no oscillations is

a) $R \geq \frac{1}{2} \sqrt{\frac{L}{C}}$  
b) $R \geq \frac{1}{2} \sqrt{\frac{L}{C}}$  
c) $R \geq \frac{1}{2} \sqrt{\frac{L}{C}}$  
d) $R = \frac{1}{\sqrt{LC}}$

Fig. 57

65) In a series RLC circuit $R=2k\Omega$, $L=1H$ and $C=\frac{1}{400}\mu F$. The resonant frequency is

a) $2 \times 10^4$ Hz  
b) $\frac{1}{\pi} \times 10^4$ Hz  
c) $10^4$ Hz  
d) $2\pi \times 10^4$ Hz

Fig. 58

66) The maximum power that can be transferred to the load resistor $R_L$ from the voltage source in figure.58 is
a) 1W  b) 10W  c) 0.25W  d) 0.5W

![Fig. 58](image)

67) For the circuit in figure.59 the instantaneous current $i_1(t)$ is
a) $\frac{10\sqrt{3}}{2} \angle 90^\circ$ Amps  c) $5 \angle 60^\circ$ Amps
b) $\frac{10\sqrt{3}}{2} \angle -90^\circ$ Amps  d) $5 \angle -60^\circ$ Amps

![Fig. 59](image)

68) Impedance Z as shown in figure.60 is:
a) $j29\Omega$  c) $j19\Omega$
b) $j9\Omega$  d) $j39\Omega$

![Fig. 60](image)

69) For the circuit shown in figure.61, thevenin’s voltage and

![Fig. 61](image)

70) If $R_1 = R_2 = R_3 = 1$ and $R_3 = 1\Omega$ in the bridge circuit shown in figure.62, then the reading in the ideal voltmeter connected between a and b is
a) 0.238 V  c) -0.238 V
b) 0.138 V  d) 1 V

![Fig. 62](image)

71) A square pulse of 3 volts amplitude is applied to C-R circuit shown in figure.63. The capacitor is initially uncharged. The output voltage $v_0$ at time t=2 sec is
a) 3V  b) -3V  c) 4V  d) -4V

![Fig. 63](image)
72) In the figure.64 shown below, assume that all the capacitors are initially uncharged. If \( v_i(t) = 10u(t) \) Volts, \( v_0(t) \) is given by

a) \( 8e^{-0.004t} \) Volts  
   c) \( 8u(t) \) Volts

b) \( 8(1 - e^{-0.004t}) \)  
   d) \( 8 \) Volts

Fig. 64

73) The RC circuit shown in the figure.65 is

a) a low-pass filter  
   c) a band-pass filter

b) a high-pass filter  
   d) a band-reject filter

Fig. 65

74) Two series resonant filters are as shown in the figure.66. Let the 3-dB bandwidth of Filter1 be \( B_1 \) and that of Filter2 be \( B_2 \). The value of \( \frac{B_1}{B_2} \) is:

a) 4  
   b) 1  
   c) \( \frac{1}{2} \)  
   d) \( \frac{1}{4} \)

Fig. 66

75) For the circuit shown in the figure.67, the Thevenin voltage and resistance looking into X-Y

a) \( \frac{4}{3} \)V,\( 2\Omega \)  
   c) \( \frac{4}{3} \)V,\( \frac{2}{3}\Omega \)

b) \( 4\)V,\( \frac{2}{3}\Omega \)  
   d) \( 4\)V,\( 2\Omega \)

Fig. 67

76) In the circuit shown in figure.68, \( V_c \) is 0 volts at \( t=0 \) sec. For \( t>0 \), the capacitor current \( i_c(t) \), where \( t \) is in seconds, is given by

a) \( 0.50 \exp(-25t) \)mA  
   c) \( 0.50 \exp(-12.5t) \)mA

b) \( 0.25 \exp(-25t) \)mA  
   d) \( 0.25 \exp(-6.25t) \)mA

Fig. 68

77) In the AC network shown in the figure.69, the phasor voltage \( V_{AB} \) (in Volts) is:

a) 0  
   b) 5\( \angle 30^\circ \)

Fig. 69
c) \(12.5 \angle 30^\circ\)

d) \(17 \angle 30^\circ\)

Fig. 69

78) The Thevenin’s equivalent impedance \(Z_{TH}\) between the nodes P and Q in the following figure.70 is

a) 1  b) \(1+s+\frac{1}{s}\)  c) \(2+s+\frac{1}{s}\)  d) \(\frac{s^2+s+1}{s^2+2s+1}\)

Fig. 70

79) The driving point impedance of the following figure.71 is given by \(Z(s)=\frac{0.2s}{s^2+0.1s+2}\). The component values are

a) \(L=5\, \text{H}, \, R=0.5\, \Omega, \, C=0.1\, \text{F}\)

b) \(L=0.1\, \text{H}, \, R=0.5\, \Omega, \, C=5\, \text{F}\)

c) \(L=0.1\, \text{H}, \, R=2\, \Omega, \, C=0.1\, \text{F}\)

d) \(L=0.1\, \text{H}, \, R=2\, \Omega, \, C=5\, \text{F}\)

Fig. 71

80) The circuit shown in the figure.72 is used to charge the capacitor C alternately from two current sources as indicated. The switches S1 and S2 are mechanically coupled and connected as follows

a) For \(2nT\leq t<(2n+1)T \; (n=0,1,2..)S1\) to P1 and S2 to P2

b) For \((2n+1)T\leq t<(2n+2)T\), \((n=0,1,2,..)S1\) to Q1 and S2 to Q2 Assume that the capacitor has zero initial charge. Given that \(u(t)\) is a unit step function, the voltage \(V_c(t)\) across the capacitor is given by

(A) \(\Sigma_{n=0}^{\infty} (-1)^n u(t-nT)\)

(B) \(u(t) + 2 \Sigma_{n=1}^{\infty} (-1)^n u(t-nT)\)

(C) \(tu(t) + 2 \Sigma_{n=1}^{\infty} (-1)^n (t-nT) u(t-nT)\)

(D) \(\Sigma_{n=0}^{\infty} [0.5 - 0.5e^-(t-2nt) + 0.5e^-(t-2nT-T)]\)

Fig. 72

81) For \(t>0\), the output voltage \(V_c(t)\) is

a) \(\frac{2}{\sqrt{3}} (e^{-\frac{1}{2}t} - e^{-\frac{\sqrt{3}}{2}t})\)

b) \(\frac{2}{\sqrt{3}} te^{-\frac{1}{2}t}\)
82) For \( t > 0 \), the voltage across the resistor is

\[ a) \frac{1}{\sqrt{3}}(e^{-\frac{\sqrt{3}}{2}t} - e^{-\frac{1}{2}t}) \]

\[ b) e^{-\frac{1}{2}t}[\cos(\frac{\sqrt{3}t}{2}) - \frac{1}{\sqrt{3}}\sin(\frac{\sqrt{3}t}{2})] \]

\[ c) \frac{2}{\sqrt{3}}e^{-\frac{1}{2}t}\sin(\frac{\sqrt{3}t}{2}) \]

\[ d) \frac{2}{\sqrt{3}}e^{-\frac{1}{2}t}\cos(\frac{\sqrt{3}t}{2}) \]

83) If the transfer function of the following figure.73 is \( \frac{V_0(s)}{V_1(s)} = \frac{1}{2+s+e^{-\pi}} \) the value of the load resistance \( R_L \) is

\[ a) \frac{R}{4} \]

\[ b) \frac{R}{2} \]

\[ c) R \]

\[ d) 2R \]

84) The switch in the figure.74 shown was on position a for a long time and is moved to position b at time \( t = 0 \). The current \( i(t) \) for \( t > 0 \) is given by

\[ a) 0.2e^{-125t}u(t) \text{ mA} \]

\[ b) 20e^{-1250t}u(t) \text{ mA} \]

\[ c) 0.2e^{-1250t}u(t) \text{ mA} \]

\[ d) 20e^{-1000t}u(t) \text{ mA} \]

85) In the figure.75 shown, what value of \( R_L \) maximizes the power delivered to \( R_L \)?

86) The time domain behaviour of an RL circuit is represented by

\[ L \frac{di}{dt} + Ri = V_0(1 + Be^{-\frac{Rt}{L}}\sin t)u(t). \]

For an initial current of \( i(0) = \frac{V_0}{R} \), the steady state value of the current is given by

\[ a) i(t) \rightarrow \frac{V_0}{R} \]

\[ b) i(t) \rightarrow \frac{2V_0}{R} \]

\[ c) i(t) \rightarrow \frac{V_0}{R}(1+B) \]

\[ d) i(t) \rightarrow \frac{2V_0}{R}(1+B) \]

87) For parallel RLC circuit, which one of the following statements is NOT correct?

\[ a) \text{The bandwidth of the circuit decreases if } R \text{ is increased.} \]

\[ b) \text{The bandwidth of the circuit remains same if } L \text{ is increased.} \]
c) At resonance, input impedance is a real quantity.

d) At resonance, the magnitude of input impedance attains its minimum value.

88) In the figure 76 shown, the switch S is open for a long time and is closed at t=0. The current i(t) for $t \geq 0^+$ is
a) $i(t)=0.5 - 0.125e^{-1000t} \text{A}$

b) $i(t)=1.5 - 0.125e^{-1000t} \text{A}$.

c) $i(t)=0.5 - 0.5e^{-1000t} \text{A}$

d) $i(t)=0.375e^{-1000t} \text{A}$

89) The current I in the figure 77 shown is
a) -j1A   b) J1A   c) 0A   d) 20A

90) In the figure 78 shown, the power supplied by the voltage source is
a) 0W

b) 5W

c) 10W

d) 100W

91) The figure 79 shown below is driven by a sinusoidal input $V_i = V_p\cos\left(\frac{t}{RC}\right)$. The steady state output $V_o$ is
a) $(\frac{V_p}{3})\cos\left(\frac{t}{RC}\right)$

b) $(\frac{V_p}{3})\sin\left(\frac{t}{RC}\right)$

c) $(\frac{V_p}{2})\cos\left(\frac{t}{RC}\right)$

d) $(\frac{V_p}{2})\sin\left(\frac{t}{RC}\right)$

92) In the figure 80 shown below, the Norton equivalent current in amperes with respect to the terminals P and Q is
a) 6.4-j4.8

b) 6.56-j7.87

c) 10+j0

d) 16+j0

93) In the figure 81 shown below, the value of $R_L$ such that the power transferred to $R_L$ is maximum
94) In the figure 82 shown below, the current I is equal to
a) $14\angle 0^\circ A$  
b) $2.0\angle 0^\circ A$  
c) $2.8\angle 0^\circ A$  
d) $3.2\angle 0^\circ A$

95) In the figure 83 shown below, the current through the inductor is
a) $\frac{2}{1+j}A$  
b) $\frac{-1}{1+j}A$  
c) $1\angle 0^\circ A$  
d) 0A

96) In the figure 84 shown below, the initial charge on the capacitor is 2.5 mC, with the voltage polarity as indicated. The switch is closed at time t=0. The current $i(t)$ at a time t after the switch is closed is
a) $i(t)=15\exp(-2\times10^3t)A$

b) $i(t)=5\exp(-2\times10^3t)A$

c) $i(t)=10\exp(-2\times10^3t)A$

d) $i(t)=-5\exp(-2\times10^3t)A$

97) The impedance looking into nodes 1 and 2 in the given figure 85 is
98) In the following figure $C_1$ and $C_2$ are ideal capacitors. $C_1$ has been charged to 12V before the ideal switch S is closed at t=0. The figure 86 i(t) for all t is

a) zero

b) a step function

c) an exponentially decaying function

d) an impulse function

99) If $V_A - V_B=6V$, then $V_C - V_D$ is, figure 87

a) -5V  b) 2V  c) 3V  d) 6V

100) Assuming both the voltages sources are in phase, the value of R for which maximum power is transferred from circuit A to circuit B is, figure 88

a) 0.8Ω  c) 2Ω

b) 1.4Ω  d) 2.8Ω

101) The transfer function $\frac{V_2(s)}{V_1(s)}$ of the figure 89 shown below is

a) $\frac{0.5s+1}{s+1}$  c) $\frac{s+2}{s+1}$

b) $\frac{3s+6}{s+2}$  d) $\frac{s+1}{s+2}$

102) In the circuit shown below, if the source voltage $V_s=100 \angle 53.13^\circ$V then the Thevenin’s equivalent voltage in Volts as seen by the load resistance $R^L$ is

a) $100\angle90^\circ$  c) $800\angle90^\circ$

b) $800\angle0^\circ$  d) $100\angle60^\circ$
103) Consider the following figure.91 for question (a) and (b).

![Figure 91](image1)

(a) The current $I_s$ in Amps in the voltage source, and voltage $V_s$ in Volts across the current source respectively, are

i) 13,-20  
ii) 8,-10  
iii) -8,20  
iv) -13,20

(b) The current in the 1Ω resistor in Amps is,

i) 2  
ii) 3.33  
iii) 10  
iv) 12

104) Find the current I in the following Branch., figure.92

![Figure 92](image2)

105) A series $R_c$ figure.93 is connected to DC voltage source at time $t_0=0$. The relation between the source voltage $V_s$, the resistance $R$, the capacitance $C$, and the current $i(t)$ is below:

$$V_s = R_i(t) + \frac{1}{C} \int_0^t i(t)\,dt.$$

Which one of the following $i(t)$ represents

![Figure 93](image3)

106) Find the resistance $R_1$ from figure.94

![Figure 94](image4)

107) Find the $V_0$, figure.95

a) $\frac{5}{2}V_1 - 3V_2$
b) $2V_1 \cdot \frac{5}{2}V_2$
c) $-\frac{3}{2}V_1 + \frac{7}{2}V_2$
d) $-3V_1 + \frac{11}{2}V_2$

![Figure 95](image5)
108) For the figure.96 given below, what will be the largest value of arm when it is converted into delta form.

![Fig. 96](image)

109) For the given figure.97, the value of capacitor is in mF. So that the system will be critically damped is

![Fig. 97](image)

110) Where \( R=1\Omega, i_1 = 2A, \ i_4 = -1A, \ i_5 = -4A \). Then which of the following is correct, figure.98

a) \( i_6=5A \)

b) \( i_3=-4A \)

c) Given data sufficient to tell these currents are not possible

d) Data is not sufficient to find \( i_2,i_3,i_6 \)

![Fig. 98](image)

111) In the figure.99 shown, at resonance, the amplitude of the sinusoidal voltage (in Volts) across the capacitor is

![Fig. 99](image)

112) In the network shown in the figure.100, all resistors are identical with \( R=300\Omega \). The resistance \( R_{ab} \) (in \( \Omega \)) of the network is

![Fig. 100](image)

113) In the given figure.101, the values of \( V_1 \) and \( V_2 \) respectively are

a) 5V,25V

b) 10V,30V

c) 15V,35V

d) 0V,20V

![Fig. 101](image)

114) In the figure.102 shown, the switch SW is thrown from positionA to positionB at time \( t=0 \). The energy (in \( \mu J \)) taken from the 3V source to charge the 0.1 \( \mu F \) capacitor from 0V to 3V is

![Fig. 102](image)
115) The damping ratio of a series RLC circuit can be expressed as

- a) \( \frac{R^2C}{2L} \)
- b) \( \frac{2L}{R^2C} \)
- c) \( \frac{R}{2} \sqrt{\frac{C}{L}} \)
- d) \( \frac{2}{R} \sqrt{\frac{L}{C}} \)

116) In the figure 103 shown, switch SW is closed at t=0. Assuming zero initial conditions, the value of \( V_c(t) \) (in Volts) at t=1 sec is

![Fig. 103](image)

117) In the given figure 104, the maximum power (in Watts) that can be transferred to the load \( R_L \) is

![Fig. 104](image)

118) The Venn diagram 105 shows the preference of the student population for leisure activities. From the data given, the number of students who like to read books or play sports is

![Fig. 105](image)

119) Social science disciplines were in existence in an amorphous form until the colonial period when they were institutionalized. In varying degrees, they were intended to further the colonial interest. In the time of globalization and the economic rise of postcolonial countries like India, conventional ways of knowledge production have become obsolete.

Which of the following can be logically inferred from the above statements?

(i) Social science disciplines have become obsolete.

(ii) Social science disciplines had a pre-colonial origin.

(iii) Social science disciplines always promote colonialism.

(iv) Social science must maintain disciplinary boundaries.

A (ii) only
B (i) and (ii) only
C (ii) and (iv) only
D (iii) and (iv) only

120) Two and a quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1:30. What is the actual current time shown by the clock?
a) 8:15  b) 11:15  c) 12:15  d) 12:45

121) In the given circuit 106, each resistor has a value equal to 1Ω. What is the equivalent resistance across the terminals a and b?

![Fig. 106](image)

122) In the circuit shown in the figure 107, the magnitude of the current (in amperes) through $R_2$ is

![Fig. 107](image)

123) In the circuit 108 shown, V is a sinusoidal voltage source. The current I is in phase with voltage V. The ratio $\frac{amplitude\ of\ voltage\ across\ the\ capacitor}{amplitude\ of\ voltage\ across\ the\ resistor}$ is

![Fig. 108](image)

124) The switch in the circuit 109 shown in the figure was open for a long time and is closed at t=0. The current $i(t)$ (in ampere) at t=0.5 seconds

![Fig. 109](image)

125) Consider the circuit shown in the figure 110. The Thevenin equivalent resistance (in Ω) across P-Q is

![Fig. 110](image)