ESC201A EndSem Part 1

SHIV NARAYAN

TOTAL POINTS

19 / 19

QUESTION 1

Q1 9 pts

1.1 1(a) 4 / 4

✓ **+ 4 pts** *Completely Correct*

+ 0 pts Completely Incorrect

+ 0 pts Not Attempted

+ 0 pts Copied

+ 2 pts Thevenin voltage calculated correctly

+ 2 pts Thevenin resistance calculated correctly

1.2 1(b) 3 / 3

✓ **+ 3 pts** *Completely Correct*

+ 0 pts Completely Incorrect

+ 0 pts Not Attempted

+ 1.5 pts Equivalent circuit at t=0+ correctly found

+ 0 pts Copied

+ 1.5 pts V correctly found

1.3 1(c) 2 / 2

✓ **+ 2 pts** *Completely Correct*

+ 0 pts Completely Incorrect

+ 0 pts Not Attempted

+ 0 pts Copied

+ 1 pts Circuit behavior at low & high freq correctly identified

+ 1 pts Nature of filter correctly identified

QUESTION 2

Q2 10 pts

2.1 2(a) 4 / 4

+ 4 pts Completely Correct

+ 0 pts Completely Incorrect

+ 0 pts Not Attempted

+ 0 pts Copied

✓ **+ 2 pts** *Circuit Simplified Correctly*

✓ **+ 1 pts** *Resonance condition identified with correct reasoning*

+ 1 pts Frequency found correctly

+ 1 *Point adjustment*

2.2 2(b) 6 / 6

✓ **+ 6 pts** *Completely Correct*

+ 0 pts Completely Incorrect

+ 0 pts Not Attempted

+ 0 pts Copied

+ 1 pts Circuit Schematic drawn correctly

+ 1.5 pts Transformer turns ratio calculated correctly

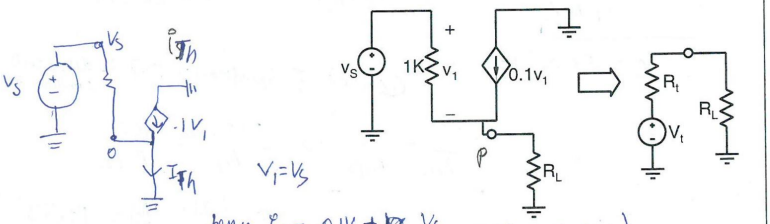
+ 1 pts Capacitance calculated correctly

+ 1.5 pts Diode peak current calculated correctly

+ 1 pts Peak Inverse Voltage calculated correctly

Name SHIV NARAYAN **Roll No.** 210978 **Seat/Room No.** 582 / L-20

1 (a). Use Thevenin's theorem to carry out the circuit transformation shown below and determine the value of Thevenin's voltage (V_t) and resistance (R_t). [4]

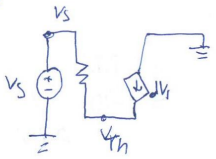


$V_1 = V_S$

hence $i_{TH} = 0.1V_1 + \frac{V_S}{10^3} = V_S\left(0.1 + \frac{1}{10^3}\right)$

V_{TH} = Potential difference Across R_L (After opening it)

i.e



$V_1 = V_S - V_{TH}$

$\frac{V_{TH} - V_S}{10^3} = .1\,V_1$

$V_{TH} - V_S = 100V_1$

$V_{TH} - V_S = 100V_S - 100V_{TH} \Rightarrow V_{TH} = V_S$

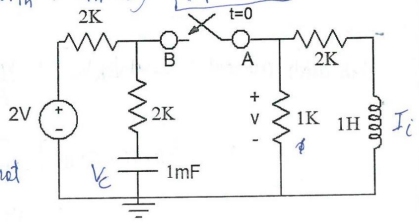
$R_{TH} = \frac{V_{TH}}{i_{TH}}$

$R_t = \frac{V_S}{V_S\left(.1 + \frac{1}{10^3}\right)}$

$= \frac{1000}{101}\,\Omega = 9.9 = R_{TH}$

$V_T = V_S$

1 (b). For the circuit shown, determine the voltage V across the 1K resistor immediately after switch is closed at t=0 . Assume that the circuit had enough time to reach steady state prior to closing of switch. [3]



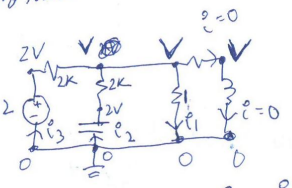
Potential Across capacitor does not change instantaneously

Current Across inductor does not change instantaneously

initially $V_C = 2V$ (PD across capacitor

Inductor initially = 0

After closing switch

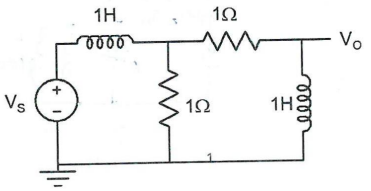


$i_1 = i_2 + i_3 \Rightarrow \frac{V}{1} = \frac{2-V}{2} + \frac{2-V}{2}$

$2V = 4 - 2V$

$V = 1\ V$

1(c). Determine the nature of the filter (low pass/high pass/band pass/band stop) shown below using qualitative arguments. [2]



at very high frequency impedance of Inductance = ∞

so $V_o = 0$

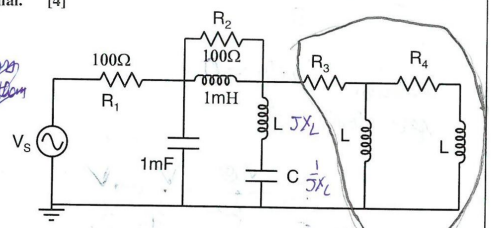
at very low impedance = 0

so $V_o = 0$

hence it is a band pass filter

at some mid range value the signal will pass

2(a). The power dissipated in resistors R_3 and R_4 in the circuit shown below was measured to be zero and power measured in resistors R_1 and R_2 was measured to be equal. Using sinusoidal steady state analysis estimate the frequency of the input signal. [4]

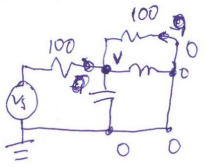


since power dissipated across R_3 & R_4 = 0 current through them = 0

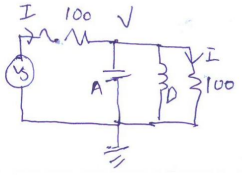
since power dissipated across R_3 & R_4 = 0 current through them = 0

$\Rightarrow 0 = jX_L + \frac{1}{jX_C}$ only then current can be zero in load

So finally our circuit is



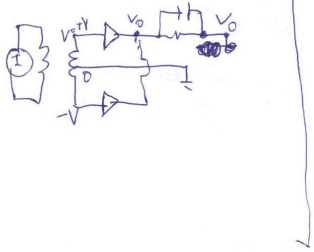
since power dissipated is same, same current passed through both (As value is also same)



for same current to pass A & B must be in resonance

or $\frac{1}{j\omega L} + j\omega C = 0$

$\Rightarrow \omega = \frac{1}{\sqrt{LC}}$



$\omega = \frac{1}{\sqrt{10^{-3} \cdot 10^{-3}}}$

$\Rightarrow \boxed{10^3 \text{ Hz}}$

2(b). Design a full wave rectifier based power supply circuit that will supply -10V to a load of 1000Ω with magnitude of ripple voltage less than 0.2V. As part of the design, sketch the complete circuit, determine transformer turns ratio, value of capacitance , diode peak current and peak inverse voltage. Assume that input is 220V rms with a frequency of 50Hz. [6]

$$V_r = \frac{V_m}{2fR_LC}$$

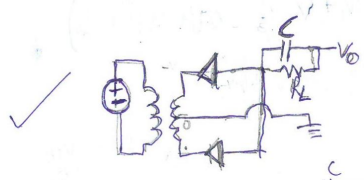
$\because \frac{V_m}{2FR_LC} < 0.2 \Rightarrow \frac{10}{2 \times 50 \times 10^3} < 0.2C$

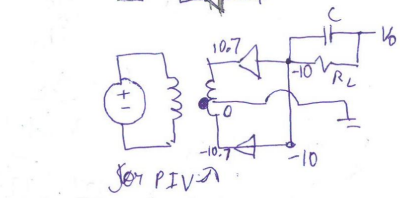
$C > 5 \times 10^{-7}$ F

Vout of transformer = 10.7 as diode will consume 0.7

$$\frac{V_1}{N_1} = \frac{V_2}{N_2/2} \Rightarrow \frac{220\sqrt{2}}{N_1} = \frac{10.7}{N_2/2}$$

$\therefore \frac{110\sqrt{2}}{10.7} = \frac{N_1}{N_2} = 14.53$





for PIV

So. PIV

$= -10 - 10.7$

$= -20.7$ V

20.7 (Vm magnitude)

$2V_m + V_r$

Peak diode current $= C\omega\sqrt{2V_r V_m} + \frac{V_m}{R}$

$= (2\pi \times 50 \times 5 \times 10^{-7})\sqrt{2 \times 10 \times 0.2} + \frac{10}{10^3}$

$0.314 + 0.01$

$= \boxed{0.324 \text{ A}}$