Electrical Engineering Department
Faculty of Engineering & Technology
University of Jordan

Electrical Circuits II (EE212)
First Exam. 1st Term, 2015-2016
Oct. 27, 2015. ⌛ 12:00 – 12:55

الاسم: ...آ.ي.ة...عبد الرحمن عبد ربه.........

St. No.: .0140754 **Seat No.:** 39 **Sec.:** 4..

9.5
20

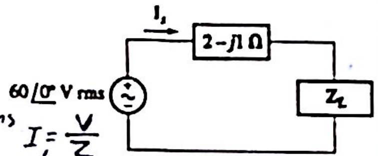
Instructor	Moh. Hajahmed ☑	Ziad Al-Khatib ☐

- *Switch off your mobile. No advanced calculators, Tablets or mobile phones are allowed.*
- *Hand over your exam sheets with your scratch paper.*
- *Show work and write the final answer & units inside the box to get credit on problems.*
- *Answer all problems ... y.*
- *Feel free to use the blank space ... work.*
- ***Please keep*** ☺, 👍 & 👂. ***Don't*** 👁, 🗣, **?**, 🎧 & ☹. *Take your* ⌛ *& enjoy yourself.*

(4.5)

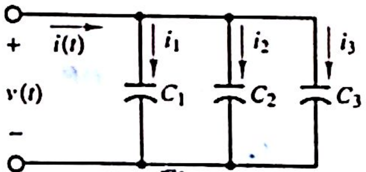
Q1-*(10Pts)* On the last blank page, solve each part separately. Then write the answer in the following table:

- For the circuit shown, If the conditions for **maximum** power transfer exist, **Determine** the:
  a- Value of Z_L. $Z_L = Z_{th}^*$
  b- Source current I_S. $I_S = \frac{V_{rms}}{Z_{-1}}$ $I = \frac{V}{Z}$
  c- Efficiency (η).($\eta = P_{out}/P_{input}$)
  Pout = Vrms * Irms, Pin = Vrms * Irms, 1∠60, $Z_L = Z_{th}^*$



$Z_L = (2 + 1j)\ \Omega$
$I_S = 15$ A
$\eta =$
(-0.5)

- In the circuit, $v(t) = 4\cos(t)$ V, $C_1 = 1$mF, $C_2 = 2$mF, $C_3 = 3$mF, **Determine** the:
  a- Current of C_2.
  b- Instantaneous power of C_2.
  c- Total average power (P).
  Z_{C} = −j1000, −500j, −333.33j
  Pavg = v(t)·i(t), .024j + 4∠0, 4∠0 × $\frac{Z_2 Z_1}{Z_2+Z_1}$, −250j

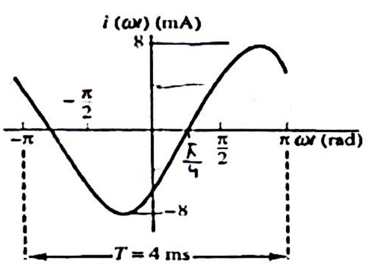


$i_2(t) = 1.33$ A
$p_2(t) = \frac{1}{2} \times 4 \times$
$P =$
(-2)

- For the given computer central processing unit (CPU) clock waveform, **find** the:
  a- Average (DC) value.
  b- Effective (rms) value.
  $T = T$, $\sqrt{\frac{1}{T}\int_0^{T/3} V_p^2\,dt} = \frac{V_p^2}{3}$

$V_{Av.} =$
$V_{rms} = \frac{V_P}{\sqrt{3}}$ volt
(-1)

Describe the sinusoidal signal in:
  a-Time domain $i(t)$.
  b- Euler's form I_E.
  c- Phasor form I.
Then **Find** the:
  d-Peak-Peak current I_{pp}.
  e-Root mean square value I_{rms}.
  f- Frequency f.



$i(t) = 8\sin(500\pi t - \frac{\pi}{4})$ mA
$I_E = 8e^{-j(500\pi t - \frac{\pi}{4})}$ mA
$I = 8\angle{-135°}$ mA
$I_{PP} = 16$ mA
$I_{rms} = 5.657$ mA
$f = 250$ Hz
(-0.5)

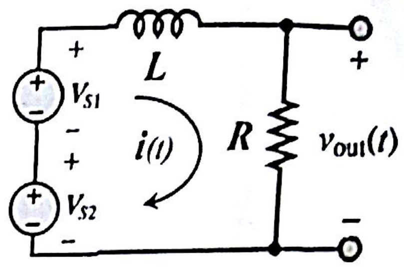
Find the phasor of:	$v = 5\cos(j2)$.	$V = 5\angle 180$
Describe the phasor form of:	$vs(t) = 7\cos(10t + 60°) + 4\sin(50t + 45°)$	$V_S =$

(-2)

6

Q2-1-(6Pts) In the circuit shown, Take: $L = 0.5$ H, $R = 10$ kΩ,

$v_{S1}(t) = 10\cos(31.4t)$V, $v_{S2}(t) = 1.2\sin(2.5\text{x}10^6 t + 30°)$V.



a- Name the proper method to solve this problem.

b- Determine $i(t)$.

c- Determine $v_{out}(t)$.

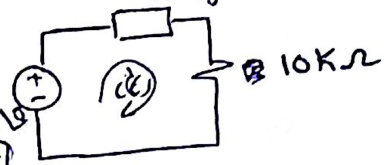
d- Determine the average power P_{out}.

e- Discuss $v_{out}(t)$ and P_{out}, respect to the frequency.

$L = j\omega L$

15.7j $\omega = 31.4$

CKT1



b) $i'(t) = \frac{10\angle 0}{10000 + 15.7j} = 9.99 \times 10^{-4} \angle -.09° \text{ A}$

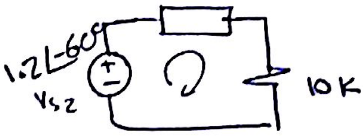
~~9.99∠-.09 V~~

~~Pout = ½ × 9.99×10⁻⁴ × 9.99 cos(0)~~

$v'_{out} = 10\angle 0 \times \frac{10^4}{10^4 + 15.7j} = 10 \angle -.09$

$P'_{out} = \frac{1}{2} \times 10 \times 9.99 \times 10^{-4} = \frac{1}{200} \text{ w} = 5 \times 10^{-3}$

CKT2



$\omega = 2.5 \times 10^6$

$i''(t) = \frac{1.2\angle -60°}{10^4 + 1.25\times 10^6 j} = 9.6 \times 10^{-7} \angle -149.5°$

$v''(t) = 1.2\angle -60 \times \frac{10^4}{10^4 + 1.25 \times 10^6 j} = 9.6 \times 10^{-3} \angle -149.5°$

$P''_{out} = \frac{1}{2} V_m \cdot I_m \cos(0) = 1.2 \times 9.6 \times 10^{-7}$ ~~= 1.1.6625×10⁻⁴~~ $= 5.76 \times 10^{-7}$ w

$P_{avg} + \frac{1}{2} V_m I_m \cos(2\omega t + \theta v + \theta i)$

a- Superposition method
b- $i(t) = i'(t) + i''(t) = 9.99 \times 10^{-4} \angle -.09 + 9.6 \times 10^{-7} \angle -149.5° = 9.98 \times 10^{-4} \angle -.012$ A
c- $v_{out}(t) = V'_{out}(t) + V''_{out}(t) = 10\angle -.09 + 9.6 \times 10^{-3} \angle -149.5 = 9.99 \angle -.012$ V
d- $P_{out} = P'_{out} + P''_{out} = 5 \times 10^{-3} + 5.76 \times 10^{-7} \simeq 5 \times 10^{-3}$ w
e- The frequency is a major factor in them

Q2-II- For the sinusoidal controlled system, the input function is: $vs(t) = 311\sin(314t)$. If the switch (S) is **OFF** at time from $[(0 \text{ to } \alpha)$ and at $(\pi \text{ to } 2\pi+\alpha)]$, and **ON** from $(\alpha \text{ to } \pi)$. **Find** the:

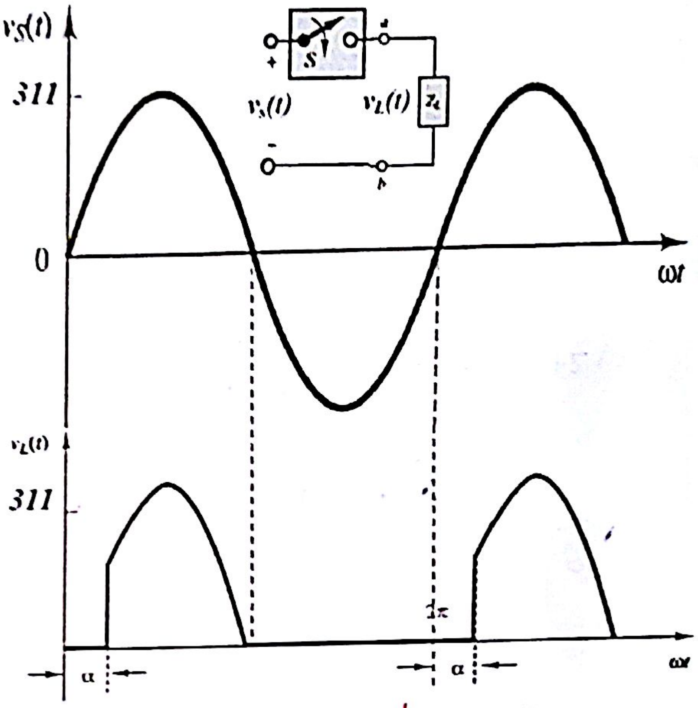
a- Average voltage of v_s.

b- rms voltage of v_s.

c- Average voltage of v_L.

d- rms voltage of v_L.

[Hint: $sin^2(x) = \frac{1}{2}(1 - cos(2x))$]



a-
b- $V_{rms} = 219.91$ V, $V_{rms} = \frac{V}{\sqrt{2}}$ → sinusoidal
c-
d-

$v_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2 dt}$

قُـمْ لِلمُعَـلِّمِ وَفِّـهِ التَبجيـلا كادَ المُعَلِّمُ أن يَكونَ رَسـولا!

أَعَلِمتَ أَشرَفَ أَو أَجَلَّ مِنَ الَّذي يَبني وَيُنشِئُ أَنفُساً وَعُقولا؟

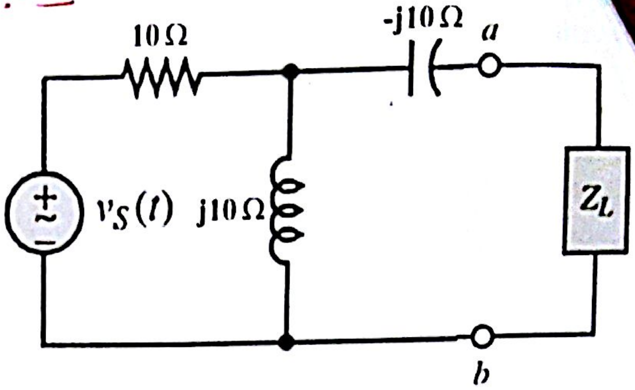
Q3- (8Pts) In the circuit shown, $v_S(t) = 40\sin(314t)$.

a- **Find, Sketch,** and **Label** the Thevenin equivalent circuit as seen from terminals *a - b*. Then **find** the:

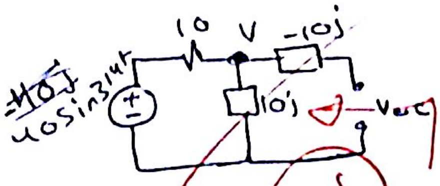
b- Load **current** at $Z_L = 6 + j8\ \Omega$.

c- Value of Z_L for **max.** power transfer.

d- Value of $Z_L = R_L$ (Z_L *replace by a pure resistive*) for **max.** power transfer.



a) $Z_{th} = -10j + \frac{10 \times 10j}{10 + 10j}$



$Z_{Th} = (5-5j)\ \Omega$

$V_{Th} =$

Sketch

b-

c-

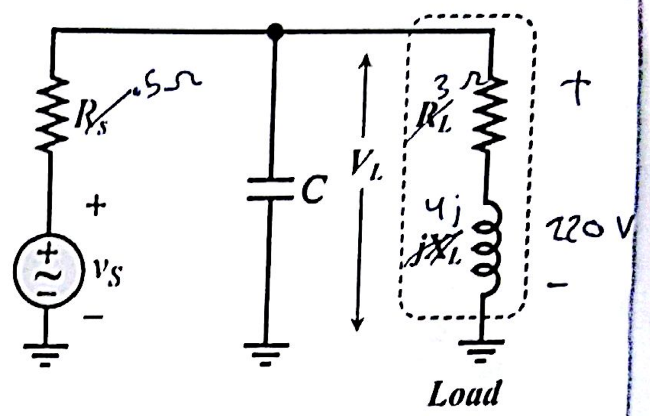
d-

Q4-(12%) The circuit shown, represents an induction motor equivalent circuit. Take: $R_S = 0.5\Omega$, $R_L = 3\Omega$, $X_L = 4\Omega$, $\bar{V}_{L,rms} = 220\angle 0°$ V, $\omega = 314$ rad/s. **Without** connecting the capacitor **C**, **Determine** the:

a- Load Current in phasor form.
b- **Complex** power S of the load.
c- **Sketch and label the power triangle** of the load.
d- Losses Power in R_S. e- Efficiency (η).

With *C connected*, **Determine** the:

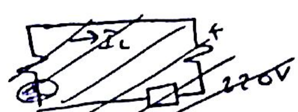
f- C value, if the power factor is to be corrected (improved) to (**0.98**) **lagging**.
g- Losses Power in R_S. h- Efficiency (η).



5.5

a) $I_L = \frac{220}{3+4j} = 44\angle -53.13$ A

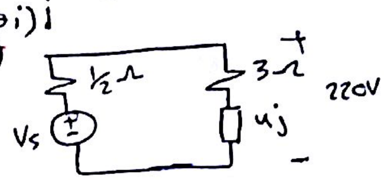
c)



b) $S = \frac{1}{2} I_m V_m \cos(\theta_v - \theta_i) + \frac{1}{2} I_m V_m \sin(\theta_v - \theta_i) j$

$= \frac{1}{2} \times 44 \times 220 \times \cos(53.1)$ ⤷ θ_2

why?



d) $P_{avg} = \frac{1}{2} I_m^2 R$ (−1.5)

f) $C = \frac{Q_C}{\omega v_{rms}^2}$ (+1)

why?

Phasor, $44\angle -53.13$

time

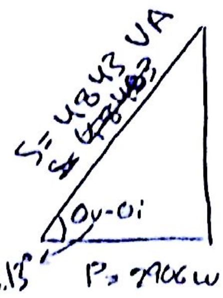
+1.5 | a- I_L = 44 cos(314t − 53.13) A

+1 | b- S = 2906 + 3870.5j VA

d- $P_{loss\ in\ R_S}$ = 484 w

+1 | e- Efficiency = $\frac{P_{out}}{P_{in}} = \frac{2906}{3870.5} = .75$

c-



+1.5

Q = 3870.5 VAR

f-

g-

h-