34/64

17/30

Electrical Engineering Department
Faculty of Engineering & Technology
The University of Jordan

الاسم: [redacted]

St. No.: 0132...38 Seat No.: 39 Sec.: 1

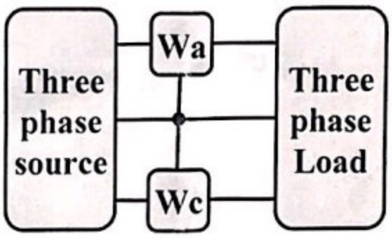
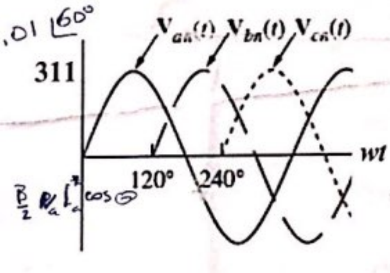
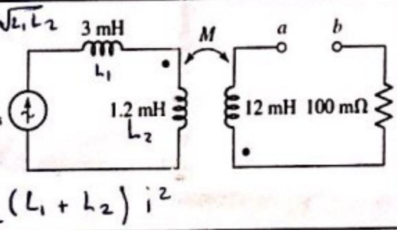
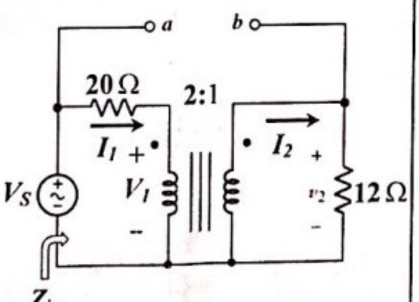
Electrical Circuits II (EE212)
Sec. Exam. 1st Term, 2015-2016
Dec. 3, 2015. ⌛ 12:25 – 13:55

Sec.1 (S, T, T, 8 - 9) Ziad Al-Khatib	Sec.1 (S, T, T, 10 - 11) Ziad Al-Khatib	Sec.4 (M, W, 11-12:30) Moh. Hajahmed
☑	☐	☐

- *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 directly on the exam sheet __only__.*
- *Feel free to use the blank space on the exam sheets for scratch work.*
- ***Please keep*** ☺, 👍 & 👂. ***Don't*** 👁, 🗣, **?**, 🎧 & ☹. Take your ⌛ & *enjoy yourself.*

18 -8

Q1-*(16Pts)* Solve each part separately. **(ABET outcome (a) Assessment)**

- The readings of the shown wattmeters are: - **Wa = 1500 W.** - **Wc = 2200 W.** - **Determine** the: - **Total** active power. - **Total** reactive power. - Power Factor. - **Type** of the load, Resistive, Inductive or Capacitive. 	P_T = 3700 W Q_T = ZERO $P.F$ = 1 unity *Type* = Resistive load -3
- The shown signals for a three-phase system Y-Y connection. $i_a(t) = 7.071\ sin(314t - 60°)$ A. a- **Write** time-varying $v_{an}(t)$. b- **Write** time-varying $v_{ab}(t)$. Then **Determine** the: c- **Total** instantaneous power $p(t)$. d- **Total** average power P. e- **Total** pulsating (time varying) power $p_{puls}(t)$. 7.01 ∠60° $\frac{3}{2} V_a I_a \cos\theta$  $V_{ab} = \sqrt{3}\, V_p\ \angle 30$	$v_{an}(t)$ = 311 sin(314t) V $v_{ab}(t)$ = 539 sin(314t + 30°) V $p(t)$ = 3298.6215 + 3298.62 cos(628+60) P = 3298.6215 W $P_{puls}(t)$ = ZERO -2
- In the circuit, $k=0.75$, if $i_s(t) = 10\ cos(200t)$ A. **Determine** the: a- Mutual Inductance M. b- V_{ab} voltage $v_{ab}(t)$. c- Max. stored energy W. $M = k\sqrt{L_1 L_2}$ $j\omega M$  $W = \frac{1}{2}(L_1 + L_2)\, i^2$	M = j0.0623 Ω $v_{ab}(t)$ = ZERO W = 0.21 J -2
- In the circuit, V_s = 220 Vrms. **Find** the: Input impedance seen by the source Z_{in}, I_1, V_1, I_2, V_2, V_{ab}, and the total dissipated power P_T.  $n = 1/2$ $Z_R = \frac{Z_L}{n^2}$ $Z_{in} = Z_L + Z_R$ $I_1 = n I_2$ $I_{1\,rms} = V_s / Z_{in} =$	Z_{in} = 68 Ω I_1 = 3.235 A (rms) V_1 = 220 V(rms) I_2 = 6.47 A (rms) V_2 = 110 V rms V_{ab} = ZERO P_T = 711.6353 W -1

$V_2 = nV_1$ $P = I_1 \lvert Z_{in} \rvert$

(6)

Q2-(8Pts) I- In the circuit shown, consider a balanced 3-phase system, given voltage in **rms**, $Z_1=Z_2=Z_3=$ **R**.

(-2)

Determine the:

a- R.

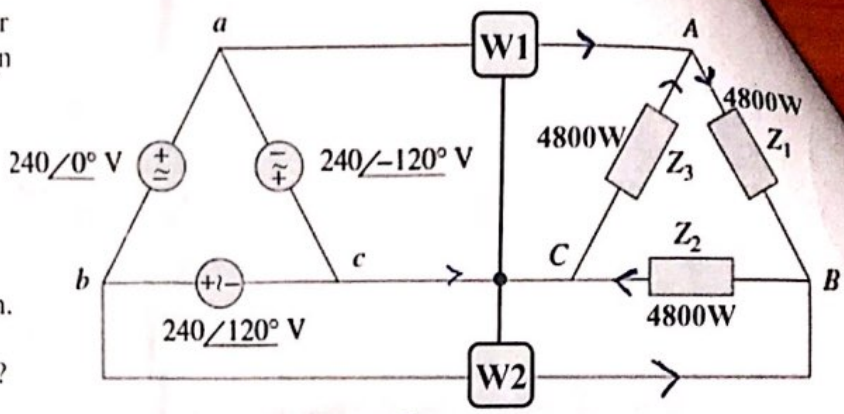
b- I_{AB}, I_{BC}, and I_{CA}.

c- I_{aA}, I_{bB}, I_{cC}.

d- Wattmeter reading of: **W1**, **W2**.

e- Type of element for **PF** correction.

f- Is the reading of (**W1** + **W2**) equals to the **total** power? **Why?**



$4800 = \frac{V^2}{R}$ $R = \frac{V^2}{P} = \frac{(240\angle 0)^2}{4800} = 12\,\Omega$

Since it's Δ-Conection Phase & line voltage are Equal

$I_{AB} = \frac{V_R}{Z_1} = \frac{240\angle 0°}{12} = 20A$

$I_{BC} = \frac{240\angle 120°}{12} = 20\angle{+120}$

$I_{CA} = \frac{240\angle -120}{12} = 20\angle -120°$

$I_{BC} = I_{AB} + I_{bB}$

I

I_{aA} $I_{AB} - I_{CA}$

$I_{bB} = I_{BC} - I_{AB}$

$I_{cC} = I_{CA} - I_{CB}$

$W_1 = V_{ac} * I_{aA}$

$W_2 = V_{bc} * I_{bB}$

R = 12 Ω
I_{AB} **=** $20\angle 0°$ A
I_{BC} **=** $20\angle{+120°}$ A
I_{CA} **=** $20\angle{-120°}$ A
I_{aA} **=** $34.64\angle 30°$ A
I_{bB} **=** $34.64\angle 150°$ A
I_{cC} **=** $34.64\angle{-90}$ A
W1 = 8313.6 W
W2 = 8313.6 W
Type: No NEED

(-2)

f- Yes, because it's a Balanced System

4

Q2-(8Pts) II- In the circuit shown, the voltage in **rms**, assume $Z_1=Z_2=Z_3=$ R=12Ω. Consider an *open circuit fault* at source *ab* (V_{ab} opened).

Determine the:

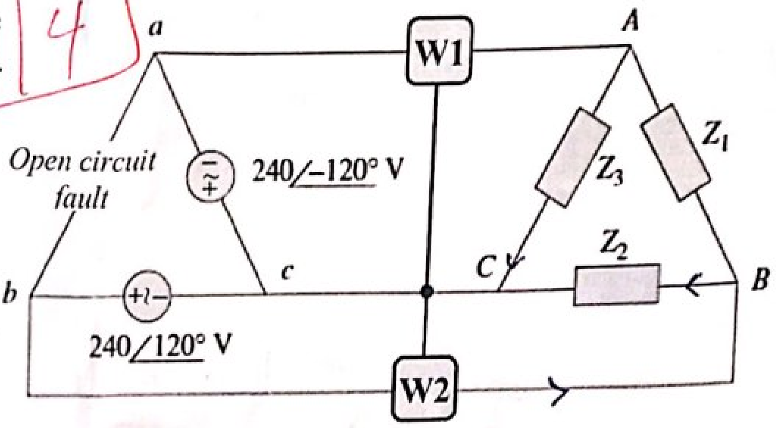
a- I_{AB}, I_{BC}, and I_{CA}.

b- I_{aA}, I_{bB}, and I_{cC}.

c- Wattmeter reading of: **W1**, **W2**.

d- System is balanced or Unbalanced.

e- What is the advantage of the DELTA connection source?



$I_{CA} = \frac{240\angle{-120^\circ}}{12}$

$I_{BC} = \frac{240\angle 120^\circ}{12} = 20\angle 120^\circ$

B

$I_{aA} = I_{AC}$

$I_{bB} = I_{BC}$

$I_{cc} = I_{BC} + I_{CA}$

$W_1 = V_{ac} * I_{cC}$

$W_2 = V_{bc} * I_{bB}$

I_{AB} =	ZERO
I_{BC} =	$20\angle 120^\circ$ A
I_{CA} =	$20\angle{-120^\circ}$ A
I_{aA} =	$20\angle 60^\circ$
I_{bB} =	$20\angle 120^\circ$
I_{cC} =	$20\angle 180^\circ$
W1=	4800
W2=	4800

1

2

d- Unbalanced

e- the total Power remains the Same even if there is a Voltage Source turned off

9

Q3-(12Pts) In the shown circuit, **Vs** = **100** Vrms.

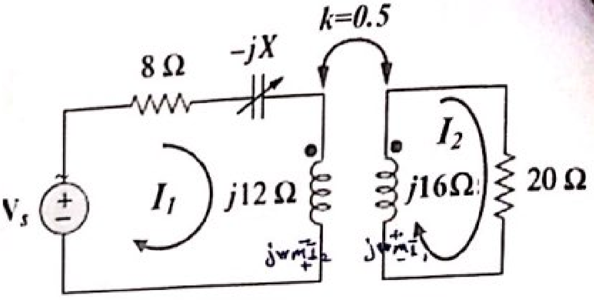
a- **Find** the mutual impedance ($j\omega M$).

b- **Write** the mesh current equations in **matrix** form.

c- **Draw** and **label** the **T** equivalent circuit **only** for the coupled coils.

d- **Find** the value of X that will give maximum power transfer to the **20** Ω load.

e- **Find** I_1 and I_2.



a- ~~jωM~~ = $M = k\sqrt{L_1 L_2}$

$= 0.5\sqrt{j12 * j16} =$

b-

mesh① $100 = 8I_1 - jX_cI_1 + j12I_1 - j6.928I_2$

$(8 - jX + j12)I_1 - (+j6.928)I_2 = 100$

mesh② $-j6.928I_1 + (20 + j16)I_2 = 0$

e- $\Delta = (160 + 128i) - -47.99 =$ $= 208 - 128i$

$\Delta_1 = 2000 + 1600i$

$\Delta_2 = j692.8$

$I_1 = \frac{\Delta_1}{\Delta} = \frac{2000 + j1600}{208 - 128i} = 10.48$

$I_2 = \frac{\Delta_2}{\Delta} = \frac{j692.8}{208 - 128}$

2

a- $j\omega M = j6.928$ Ω

b-

$\begin{bmatrix} 8 - jX + j12 & (-j6.928) \\ (-j6.928) & 20 + j16 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \end{bmatrix}$

+4

c-

j5.072 j9.072

j6.928

+3

d- $X =$ −j12

e-

$I_1 = 10.487 \angle 70.26°$ A

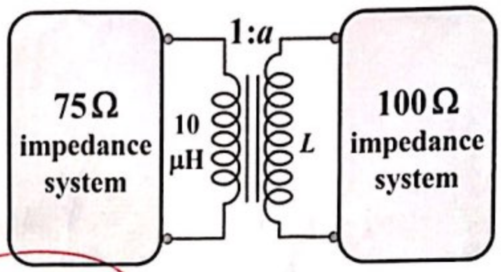
$I_2 = 2.836 \angle 121.6°$ A

7

Q4-(6Pts) **I-** A transformer is used to match the different impedance systems with each others. A computer/electrical/mechatronics engineer want to couple a coaxial cable with BNC socket to UTP cable with RJ-45 socket as shown in the figure, the used transformer is an **ideal**, **determine** the:

a- Required turns ratio (*a*) for maximum energy power transfer.

b- Inductance *L* value in **100**-ohm side.



3

$Z_R = Z_L / n^2$

$\frac{Z_2}{Z_1} = n^2$

$\frac{L_2}{L_1} = n^2$

+3

a- $a =$ 1.547

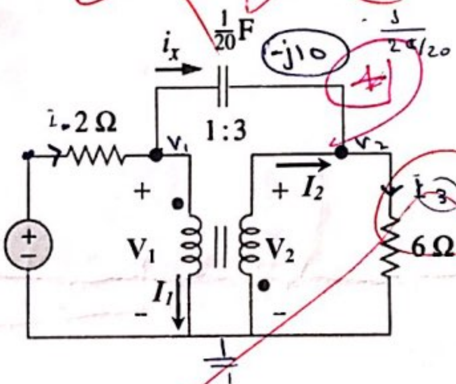
b- $L =$ j15.47

Q4-(10Pts) **II-** In the shown circuit, the transformer is an **ideal**, $v_s(t) = 10\cos(2t)$ V. **determine** the following:

a- Primary voltage and current V_1, I_1.

b- Secondary voltage and current V_2, I_2.

c- Feedback current i_x.



4

$\frac{10 - V_1}{2\,\Omega} = I_0$ --- (1)

$\frac{V_1 - V_2}{-j10} = i_x$ --- (2)

$\frac{V_2}{6} = I_3$ --- (3)

$I_2 = I_3 - i_x$

$V_2 = 3V_1$

$I_1 = 3I_2$

+1

$V_2 = 3V_1$

$I_1 = 3I_2$

mesh①

$10 = 2I_1 + V_1$

mesh②

$+V_1 = -j10\,I_x + V_2$

mesh③

$V_2 = 6I_2$

a- $V_1 =$

$I_1 =$

b- $V_2 =$

$I_2 =$

c- $i_x =$