FNU FIJI NATIONAL UNIVERSITY

C4EL3, EEE391 ELECTRICAL PRINCIPLES 2. PENSTER 2.

EXAMINATION ANSWERS.

SECTION A (20 MARKS) Brief written answers.

1.a. Resistance: there is no phase shift between the voltage and the current.

($P_{av} = V_{r.m.s} * I_{r.m.s}$). (1 mark)

1.b. Inductance: 90° phase shift; current lagging – $P_{av} = 0$. (1 mark)

1.c. Capacitance: 90° phase shift; current leading – $P_{av} = 0$ (1 mark)

2. It is a combined opposition to the current flow in both resistance and reactance. (2 marks)

3. In a series circuit the current is common to all parts and the total voltage is the phasor sum of all the individual voltage drops. (2 marks)

4.a. Copper loss (1 mark)

4.b. Iron loss (1 mark)

5. The total loss in the inductor is equal to the sum of copper and iron losses. (2 marks)

6.a. True power (P) – In a purely resistive circuit V and I are in phase with each other and the power consumed is, P = $V \times I$. This is still true in principle but here the in-phase component of voltage must be used instead i.e. $P = V_R \times I$. (3 marks)

6.b. Apparent power (S) – For circuits that consists of combination of resistance and reactance, the product of line voltage and current does not equal the

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power consumed and cannot be expressed in watts.
Apparent power ($S = V \times I$) is measured in volt-amperes (VA). (3 marks)

6.c. Reactive power (Q) – Is found by the product of the line voltage and the proportion of line current that does not consumed power. Reactive power is called wattles power and for this reason, it is measured in "volt-amperes, reactive, abbreviated "var". (3 marks)

C4EL3, EEE 391-ELECTRICAL PRINCIPLES 2

SECTION B. CALCULATION SOLUTIONS.

1. a. XL = $2\pi fL$ 1 mark
XL = $2\pi(40)(250 \times 10^{-3})$ 1 mark

XL = 62.83 Ω 1 mark

1. b. XC = $^{1}/_{2\pi fC}$ 1 mark
XC = $^{1}/_{[2\pi(40)(2.0 \times 10^{-6})]}$ 1 mark

XC = 1989.4 Ω 1 mark

1. c. Z = $\sqrt{R^2 + (XL - XC)^2}$ 1 mark

Z = $\sqrt{[(150)^2 + (62.83 - 1989.4)]^2}$ 1 mark

Z = 1932.4 Ω 1 mark

1. d. Z = $^{V}/_{I}$

I = $^{V}/_{Z}$ 1 mark

I = $^{210}/_{1932.4}$ 1 mark

I = 0.1087 Ampere 1 mark

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1. e. $\emptyset = {}^{R}/_{Z,}\ \emptyset = {}^{150}/_{1932.4}$ 1 mark

$\emptyset = 0.0776$ 1 mark

$\underline{\cos\theta = 85.5°}$ 1 marks

2. $1/C\ total = 1/C_1 + 1/C_2 \ldots$

$1/C_{T=}\ 1/10 + 1/5$ 1 mark

$C_{T=}\ 10/3$ 1 mark

$\underline{= 3.3\ \mu F}$ 1 mark

3. $Q = V.C$

$= 40 \times 300/10^6$ 1 mark

$\underline{Q = 0.12\ coulomb}$ 1 mark

4. $R = V/I = \frac{240}{12} = 20\Omega \quad \ldots\ldots\ldots\ldots .D.C.Circuit$ 1 mark

$Z = V/I = \frac{240}{6} = 40\Omega \quad \ldots\ldots\ldots\ldots .A.C.Circuit$ 1 mark

$p.f. = \cos\theta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Series\ Cicuit$

$R/Z = \frac{20}{40} = 0.5$ 1 mark

$\underline{\emptyset = 60°}$ 1 mark

5. $P.F = P/S = 500/240 \times 3$ 1 mark

$= 500/720$ 1 mark

$\underline{p.f. = 0.69}$ 1 mark

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6. $P = V.I.cos\theta$

$I = P/V.cos\vartheta$ 1 mark

$I = 1150/240 \times 0.54$ 1 mark

$\underline{I = 8.87\ Amperes}$ 1 mark

7. $Z = \sqrt{R^2 + XL^2}$ 1 mark

$Z = \sqrt{20^2 + 16^2}$ 1 mark

$\underline{Z = 25.6\ \Omega}$ 1 mark

$cos\theta = R/Z$ 1 mark

$cos\theta = 0.78$ 1 mark

$\underline{phase\theta = 38.6°}$ 1 mark

8.a. $XL = 2\pi fL = 2 \times 3.14 \times 50 \times 0.06 = 18.8\Omega$ 1 marks

$I_L = V/X_L = 240/18.8 = 12.76\ Amperes$ 1 marks

$I_R = V/R = 240/30 = 8.0\ Amperes$ 1 marks

$I_{Total} = \sqrt{R^2} + I_L^2 = \sqrt{8^2} + 12.76^2 = 15\ Amperes$ 1 marks

8.b. The I_{Total} lags behind V by an r.m.s. value of angle θ.

The p.f. of the circuit is:

$p.f. = cos\theta = I_R\ /I_T = 8/15 = 0.533333$ 2 marks

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8.c. $P = V.Icos\theta = 240 \times 15 \times 0.533333 = 1920\ watts$ 2 marks

With negligible resistance in the inductance the power

in the resistor represents the total power in the circuit:

P= $I_R^2.R = 8^2 \times 30 = 1920\ watts$

9. Power factor= $P/S = 500/240 \times 2.7$ 1 mark

$= 500/648$ 1 mark

$\underline{p.f. = 0.77}$ 1 mark

10.a. $I = {}^{V}/_{R}$

$= {}^{240}/_{7.9}$ 1 mark

$I = 30.4\ Amperes$ 1 mark

10.b. $P = V.I$

$= 240 \times 30.38$ 1 mark

$= 7{,}291 Watts$

$P = 7.3kW$ 1 mark

11.a. $v = V_{max.} sin\theta$ 1 mark

$= 220 \times 0.5$ 1 mark

$= 110V$ 1 mark

Cont…

11.b. $v = 220\ sin150°$

$= 220\ \sin(180 - 150)°$ 1 mark

$= 220\ sin30°$

$= 220 \times 0.5$ 1 mark

$= 110V$ 1 mark

11.c. $v = 220\ sin310°$

$= 220[-\sin(360 - 310)°]$ 1 mark

$= 220(-sin50°)$

$= 220 \times -0.76$ 1 mark

$= -168.5V$ 1 mark

SECTION C (20 MARKS) SHORT ANSWERS.

	(Marks)		(Marks)
1. Impedance	(1)	11.Current	(1)
2. Current	(1)	12.Farads (F)	(1)
3. Voltage	(1)	13.$P = iV \times iI$	(1)
4. Copper loss	(1)	14.Zero	(1)
5. Eddy current and hysteresis loss	(2)	15.I leads V by 90°	(1)
6. Current increases	(1)	16.Stacked plate, rolled, electrolytic, variable and ceramic capacitor.	(1)
7. Inductive loads	(1)	17. No negative value of power	(1)
8. Resonance	(1)	18. Parallel R-L-C circuit	(1)
9. Inductive reactance	(1)		
10. current opposition increases, e.m.f increases.	(2)		

END
