ELEN 20005 FOUNDATIONS OF ELECTRICAL NETWORKS
Semester 2 Exam 2017
Numerical Answers

Question 1

(a) The clockwise mesh currents are $i_1 = 2\ A$, $i_2 = -1\ A$, $i_3 = -0.8\ A$, $i_4 = -1\ A$.
(b) $v_1 = -19\ V$, $v_2 = 4\ V$.
(c) Absorbing $0.8\ W$ of power. (d) $L = 3.3\ mH \pm 2\%$ (e) $C = 4.7\ nF$

Question 2

(a) $V_C(0^+) = 10\ V$, $V_C(t) = 10e^{-200t}\ V$. (b) $8\ ms$.
(c) $w_C(0) = 125\ \mu J$, $w_C(t) = 125e^{-400t}\ \mu J$.

Question 3

(b) $V_{ab} = 762\underline{/30^\circ}\ V$, $I_{aA} = 88\underline{/-36.9^\circ}\ A$ (c) $V_{AB} = 762\underline{/30^\circ}$, $I_{AB} = 50.8\underline{/-6.9^\circ}\ A$
(d) $\theta = 36.9^\circ$, $P = 15.5\ kW$, $Q = 11.6\ kVAR$.

Question 4

(a) $V_T = 80\underline{/0^\circ}\ V$, $Z_T = 41.2\underline{/14.1^\circ}\ \Omega$ (b) $\mathbf{V} = 20\underline{/-90^\circ}\ V$, $v(t) = 20\cos(1000t - 90^\circ)\ V$.

Question 5

(a) $A_m = 10\ V$, $\omega = 500\pi\ rad/s$, $\theta = -90^\circ$. (b) V_2 lags V_1 by 54°.

Question 6

(b) $i(t) = 3.5\cos(1000\pi t + 14.5^\circ)\ mA$, $v_C(t) = 0.5\cos(1000\pi t - 75.5^\circ)\ V$,
phase difference is 75.5°

Question 7

$i(0) = 1\ mA$, $i(2) = 2\ mA$ with quadratic curve inbetween;
$i(2) = 2\ mA$, $i(4) = 2\ mA$ with constant curve inbetween;
$i(4) = 2\ mA$, $i(5) = 1\ mA$ with straight line inbetween.

$p(0) = 0\ mW$, $p(2^-) = 30\ mW$ with cubic curve inbetween;
$p(2^+) = 0\ mW$, $p(4^-) = 0\ mW$ with constant curve inbetween;
$p(4^+) = -30\ mW$, $p(5) = -15\ mW$ with straight line inbetween.

$w(0) = 7.5\ nJ$, $w(2) = 30\ nJ$ with quartic curve inbetween;
$w(2) = 30\ nJ$, $w(4) = 30\ nJ$ with constant curve inbetween;
$w(4) = 30\ nJ$, $w(5) = 7.5\ nJ$ with quadratic curve inbetween.

Question 8

(a) $Y = \overline{A}\ \overline{B} + \overline{A}\ \overline{C}$ (c) False

Question 9

(a) $Z = \overline{BC + \overline{B(A+C)}}$ (b) $Z(AB\overline{C}) = 1$, otherwise $Z = 0$.

(c) The worst-case propagation delay goes through the OR gate, the NAND gate and the NOR gate with total $t_{pd} = 58\ ns$.

Question 10

$$v_{out} = \begin{cases} \frac{1}{3}(v_{IN} + 7\ V), & \text{if } v_{IN} \geq 14\ V \\ \frac{1}{2}v_{IN}, & \text{if } v_{IN} < 14\ V \end{cases}.$$