# TEST - II SOLUTION / Marking scheme

Aug - NOV 2018

Class: F.Y. B.Tech

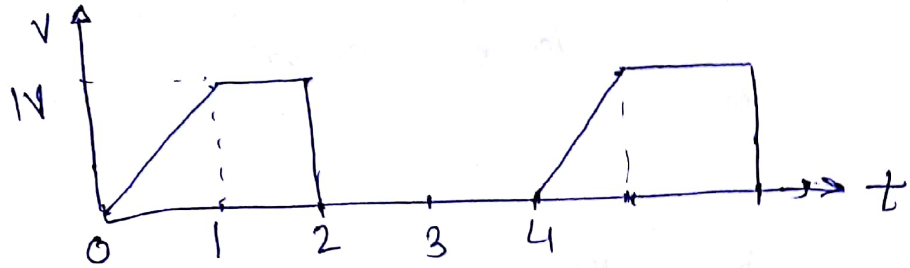
Sub: EEBE

Date: 14-11-2018

Max Marks: 40

Duration: 1 hr 30 min.

Q1:




Soln:

$$\left.\begin{array}{ll} v = t & ; \quad 0 < t < 1 \\ v = 1\,V & ; \quad 1 < t < 2 \\ v = 0 & ; \quad 2 < t < 4 \end{array}\right\} \text{(02M)}$$

i) Average value:

$$V_{avg} = \frac{1}{T}\int_0^T v(t)\,dt$$

$$= \frac{1}{4}\left[\int_0^1 t\,dt + \int_1^2 1\,dt + \int_2^4 0\,dt\right]$$

$$= \frac{1}{4}\left[\left[\frac{t^2}{2}\right]_0^1 + [t]_1^2 + 0\right]$$

$$= \frac{1}{4}\left[\frac{1}{2} + 2 - 1\right] = \frac{1.5}{4} = 0.375\,V$$

$$\therefore \boxed{V_{avg} = 0.375\,V}$$

(03M)

(ii) RMS value:

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt} = \sqrt{\frac{1}{4}\left[\int_0^1 t^2\,dt + \int_1^2 1\,dt + 0\right]}$$

$$= \sqrt{\frac{1}{4}\left[\left[\frac{t^3}{3}\right]_0^1 + [t]_1^2\right]} = \sqrt{\frac{1}{4}\left[\frac{1}{3} - 0 + 2 - 1\right]} = \sqrt{0.333}$$

$$= 0.577\ V.$$

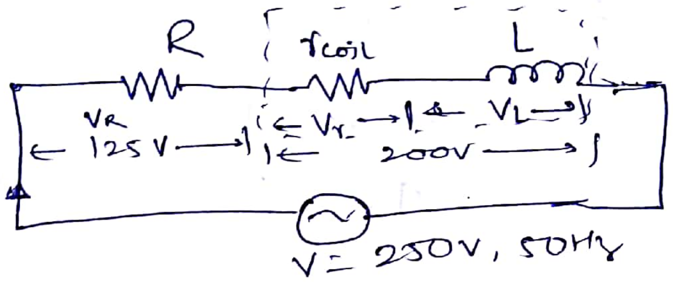
poo

$\therefore \boxed{V_{rms} = 0.577^{\circ}\ V}$ } (03M)

Crest factor $= \dfrac{V_m}{V_{rms}} = \dfrac{1}{0.577} = 1.733$ } (01M)

form factor $= \dfrac{V_{rms}}{V_{avg}} = \dfrac{0.577}{0.375} = 1.538$ ] (01M)

Que 2 :




i) Resistance $R = \dfrac{V_R}{I} = \dfrac{125}{5} = 25\Omega$ } (01M)

$Z_{coil} = \dfrac{V_{coil}}{I} = \dfrac{200}{5} = 40\Omega$ } (01M)

~~Z~~ Total impedance of ckt $= Z_T = \dfrac{V}{I} = \dfrac{250}{5} = 50\Omega$

$Z_{coil} = \sqrt{r^2 + X_L^2}$

$\Rightarrow (40)^2 = r^2 + X_L^2$ — (1)

also, $Z_T = \sqrt{(R+r)^2 + X_L^2}$

$\Rightarrow (50)^2 = (R+r)^2 + X_L^2$

$(50)^2 = (25+r)^2 + X_L^2$ — (2)

from eqn (1) & (2)

$\boxed{r = 5.5\Omega}$ ; $\boxed{X_L = 39.62\Omega}$ (02M)

(ii) Power consumed by coil $= P_{coil} = I^2 r = 5^2 \times 5.5 = 137.5\ W$

$\therefore \boxed{P_{coil} = 137.5\ W}$

Total power consumed by ckt $= I^2(r+R) = 5^2(5.5+25)$

$\boxed{P_{total} = 762.5\ W}$ (02M)

page (2)

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(iii) P.f. of coil $= \frac{r}{Z_{coil}} = \frac{5.5}{40} = 0.1375$

$\therefore \boxed{P.f_{coil} = 0.1375 \text{ Lagging}}$ (02M)

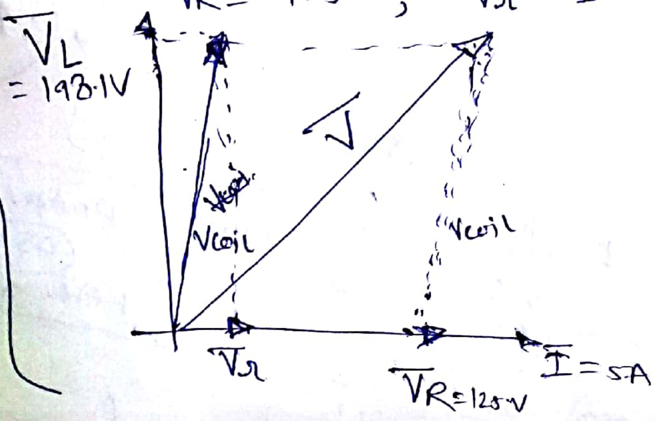
Phasor diagram: $\phi_{coil}$

$\bar{V} = \bar{V_R} + \bar{V_{coil}}$ , $\phi_{coil} = \cos^{-1}(0.1375)$

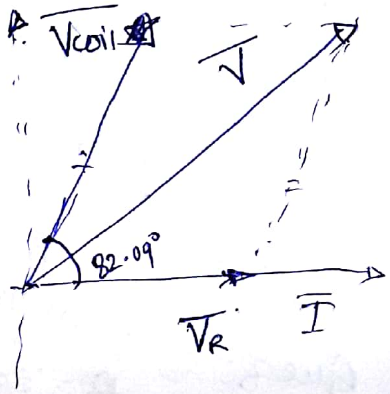
$= \bar{V_R} + \bar{V_r} + \bar{V_L}$ $= 82.09°$

$V_R = 125$ , $V_r = I \cdot r = 27.5\,V$, $V_L = IX_L = 198.1\,V$

(02M)

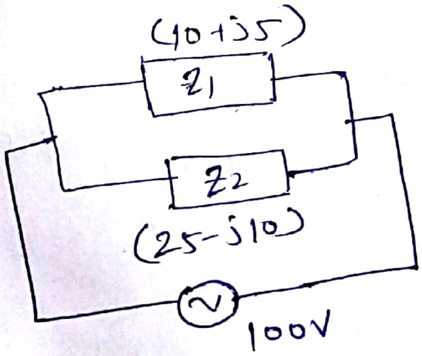



OR




OR

Q2:




Soln: - Total Admittance: (Y)

(01M) $Y_1 = \frac{1}{Z_1} = \frac{1}{10+j5} = \frac{1}{11.180\angle 26.565} = 0.0894 \angle -26.565$ ℧ (01M)

$Y_1 = (0.07996 - 0.03998j)$ ℧

(01M) $Y_2 = \frac{1}{Z_2} = \frac{1}{25-j10} = \frac{1}{26.925\angle -21.801} = 0.0371 \angle 21.801$ ℧ (01M)

$Y_2 = (0.03444 + 0.01377j)$ ℧

$Y = Y_1 + Y_2$

$Y = 0.1144 - 0.0262j$ ℧

$Y = 0.1175 \angle -12.9$ ℧ (02M)

i.e. $Y = 0.1145 - 0.0262$ ℧

$Y =$

Total Current $I = \frac{V}{Z_{total}}$

$Z_{total} = \frac{1}{Y_{total}} = \frac{1}{0.1175 \angle -12.9}$ } 01M

$\boxed{Z_{total} = 8.510 \angle 12.9 \ \Omega}$

$\boxed{Z_{total} = 8.295 + 1.899j \ \Omega}$

$\therefore I = \frac{100}{8.510 \angle 12.9} = 11.750 \angle -12.9 \ A$ } 01M

$\therefore \boxed{I = 11.750 \angle -12.9 \ A}$

Phasor diag (03M) Refer page (7)

(iii) $P = I^2 R = 1145.22\ W$
$= (11.750)^2 \times 8.295 = 1145.22\ W$ } 01M

Que 3: $R = 30\ \Omega$


} ~~01M~~

Soln:- Current is max at 400 Hz freq,
i.e. $f_r = 400$ Hz, & $I_r = 0.5A$.

at resonance, $I_r = \frac{V}{R + r}$

$0.5 = \frac{50}{(30 + r)}$

$\Rightarrow (r + 30) = 100 \Rightarrow \boxed{r = 70\Omega}$

$V_C = I_r X_C$

$X_C = \frac{V_C}{I_r} = \frac{150}{0.5} = 300\Omega$

} 04M

at resonance $X_C = X_L = 300\Omega$

$\therefore 2\pi f_r L = 300\ \Omega \Rightarrow L = \frac{300}{2\pi \times 400} = 119.42$ mH

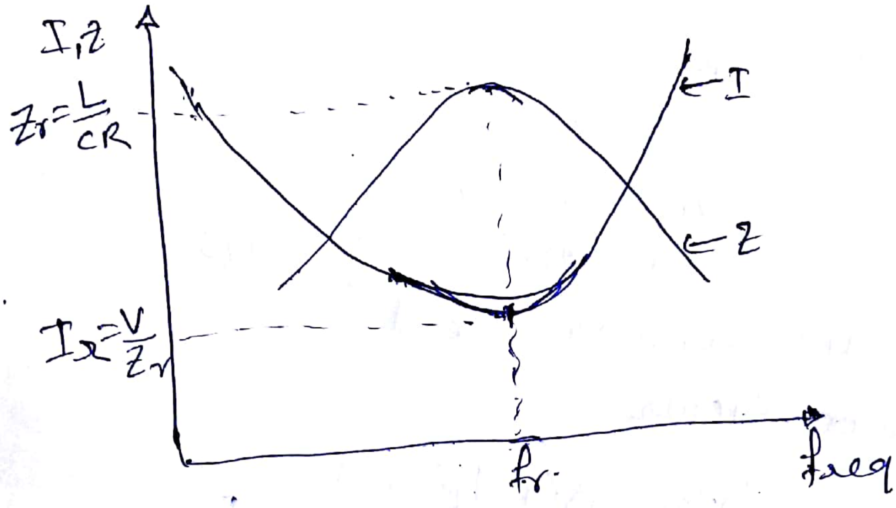
$\therefore \boxed{L = 119.42\ mH}$

04M

page (4)

Q3: (ii) Parallel Resonance curve.

(02M)




Q4: Given: $V_L = 415V$
$f = 50Hz$
$I_{ph} = 20A$
$\phi = 30°$

For star connected load,

i) phase voltage $V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{415}{\sqrt{3}} = 239.6V$ (02M)

$\therefore \boxed{V_{ph} = 239.6V}$

ii) power :

$I_L = I_{ph} = 20A$

$P = \sqrt{3}\ V_L . I_L . \cos\phi = 12.45\ KW$ (03M)

iii) Circuit parameters:

$Z_{ph} = \frac{V_{ph}}{I_{ph}} = \frac{239.6}{20} = 11.98\ \Omega$ (02M)

$\bar{Z}_{ph} = 11.98 \angle 30° \Omega = 10.37 + j6\ \Omega$ (02M)

$\therefore \boxed{R_{ph} = 10.37\ \Omega}$, $X_{ph} = 6\Omega = 2\pi f L_{ph}$

$\therefore \boxed{L_{ph} = 19.1\ mH}$ (01M)

OR

Q4: Given: $L = 50\ mH$

$R = 50\ \Omega$

$C = 50\ \mu F$

$V_L = 550\ V$

$\omega = 2\pi f = 800\ rad/s$

For a delta connected Load,

i) Power factor

$$\bar{Z}_{ph} = jX_L + (R \,||\, (-jX_C))$$

$$= jX_L + \frac{R(-jX_C)}{R - jX_C}$$

$X_L = \omega L = 40\ \Omega$

$X_C = \frac{1}{\omega C} = 25\ \Omega$

02M

$$\therefore Z_{ph} = j40 + \frac{50(-j25)}{50 - j25} = j40 + \frac{1250\angle -90}{55.901\angle -26.565}$$

$= j40 - 10.00 - j20.00$

$= +10 + j20\ \Omega$

$Z_{ph} = 22.36\angle 63.43^\circ\ \Omega$

$\Rightarrow \phi = 63.43^\circ$

$\therefore$ P.f. $= \cos\phi = 0.447$ Lagging

02M

(ii) Phase current:

$V_L = V_{ph} = 550V$.

$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{550}{22.36} = 24.6A$

02M

(iii) Line current $I_L = \sqrt{3}\, I_{ph} = 42.61A$

01M

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(iv) power consumed :

$P = \sqrt{3}\, V_L I_L \cdot \cos\phi$

$= \sqrt{3} \times 550 \times 42.61 \times 0.447 = 18.14\ KW$

$\boxed{P = 18.14\ KW}$

(v) Reactive power

$Q = \sqrt{3}\, V_L I_L \sin\phi = \sqrt{3} \times 550 \times 42.61 \times \sin(63.43)$

$\boxed{Q = 36.3\ KVAR}$

03M

~~page 7~~

8R, 14.11.18

CNTD — Page (04)

Q : 2 : (10M)

Phasor diagram :—

$\bar{I}_1 = \frac{V}{\bar{Z}_1} = \frac{100}{10+j5} = \frac{100}{11.180\angle 26.565}$

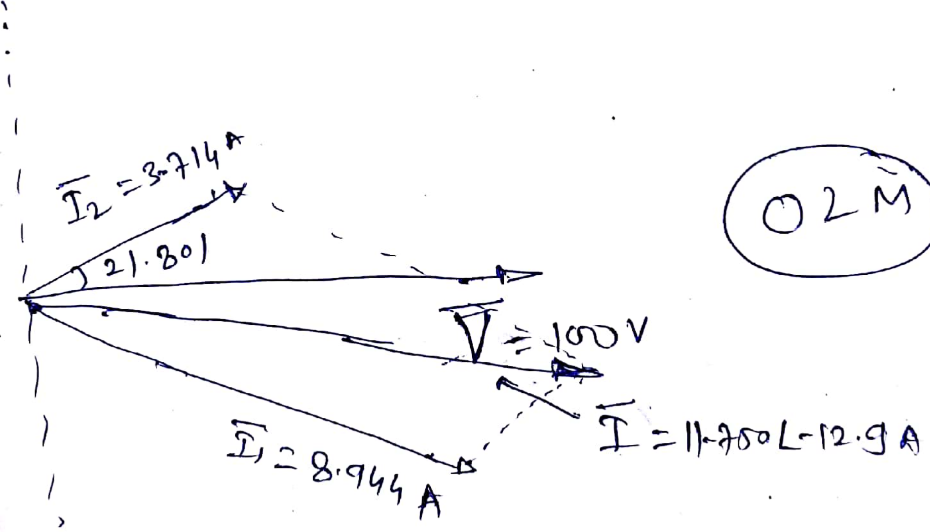
$\Rightarrow \boxed{\bar{I}_1 = 8.944\ \angle -26.565\ A}$

$\bar{I}_2 = \frac{V}{\bar{Z}_2} = \frac{100}{26.925\angle -21.801} = 3.714\ \angle 21.801\ A$

$\boxed{\bar{I}_2 = 3.714\ \angle 21.801\ A}$

01M

$\bar{I} = \bar{I}_1 + \bar{I}_2$




02M



8R 15.11.18