Dept. of Elect. Eng

Power Electronics (0943461)

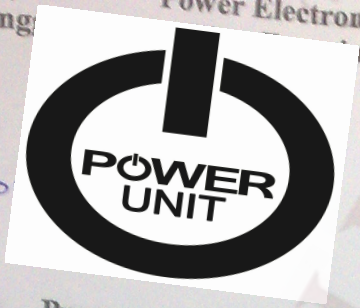
ation

Date: 21.3.2011
Time: 1Hrs

Name(in Arabic)

Student No.

Section



2 (12-1pm)

Programmable calculators are not allowed.
Derive any formula you use.

1. A voltage of $v(t) = 100 \sin(100\pi t)$ V, is applied to a certain non-linear load. The flowing current is given by:
$i(t) = 2 + 9\sin(100\pi t) - 12\cos(100\pi t) + 5\sin(300\pi t)$ A
Find:

(i) The rms value of the current **4marks**

$2 + 9\cos(100\pi t - \pi/2) - 12\cos(100\pi t) + 5\cos(300\pi t - \pi/2)$

$2 + 15\angle -143.13 + 5\angle -\pi/2$

$= \sqrt{129}$ A

(ii) The power factor

$pf = \dfrac{P}{V_{rms} * I_{rms}} = \dfrac{(\sqrt{129})\left(\frac{15}{\sqrt{2}}\right)\left(\frac{100}{\sqrt{2}}\right)}{\left(\frac{100}{\sqrt{2}}\right)\sqrt{129}}$ $I_{1rms} = 15/\sqrt{2}$ $V_{1rms} = 100/\sqrt{2}$

$\dfrac{(15/\sqrt{2})}{\sqrt{129}} * \cos(-90 - (-143.13)) = 0.933$ $= 0.560$

(iii) The distortion volt ampere

$= S^2 - P^2 - Q^2$

$\dfrac{I_{1rms}}{I_{rms}} = \dfrac{(15/\sqrt{2})}{(\sqrt{129})} = 0.933$

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(iv) The total harmonic distortion

2. A single phase half wave rectifier with an RL load and a freewheeling diode. $V_m = 200V$. $R = 10\ \Omega$, $L = 0.05H$, f=50Hz. Find

(i) The output average current **4marks**

$\phi = \tan^{-1}\left(\frac{\omega L}{R}\right)$

$I_{rms} = \frac{200}{\sqrt{2}} = 141.42$

$I_{dc} = \frac{V_m}{\pi R} = 6.369$

(ii) The rms value of the output current

$$\frac{V_m}{\pi} + \frac{V_m}{2}\sin(\omega_0 t) - \sum \frac{2V_m \cos(2n\omega_0 t)}{4n^2 - 1}$$

n	V_n	Z	X	I_n	I_{rms}
0	63.7	10	0	6.37	6.37
1	100	18.6	15.7	5.37	3.798
2	42.46	32.95	31.4	1.28	.904
4	8.49	63.6	62.8	.133	0.094

} n

4

$n = 1$

$X = (2\pi f)(L)$

$= \frac{n\pi}{4}$

$I_{rms} = \sqrt{(6.37)^2 + (3.798)^2}$

$= 7.416$

(iii) The output power

$P = I_{rms}^2 (R)$

$= (7.416)^2 (10) = 550.01$

(iv) The supply power factor

$PF = \frac{(550)}{(200/\sqrt{2})(7.416)} = 0.524$

3. A single phase half wave rectifier with a resistive load and a smoothing capa
$V_m = 200V, R = 1\,k\Omega, C = 100\mu F, f = 50Hz$ **6marks**

Find the following

a. Value of the angle θ in degrees (When the diode stops)

$\omega = 2\pi f$

$2 \times 3.14 \times 50$

$\omega RC = 31.4$

$\pi - \tan^{-1}(\omega RC)$

91.82°

b. Value of the angle α in degrees (When the diode starts)

$\pi - 91.82$

$= 88.18$

55°

c. The output voltage ripple.

$\frac{\Delta V}{V_m} = V_m(1 - \sin\alpha) = 3616$

$\text{Ripple} = \frac{\Delta V}{V_m} = .1807$

d. The equation of the diode current as function of time

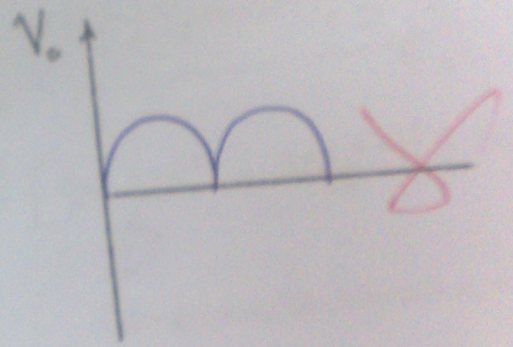
$i_D(t) = i_C + i_R$

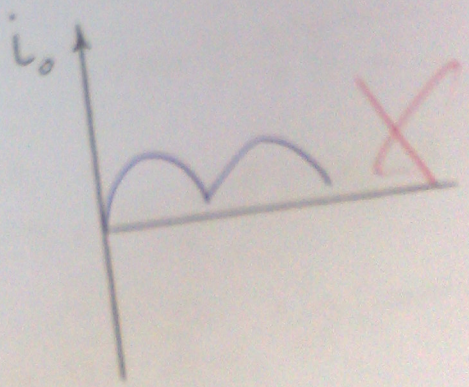
$\frac{\omega V_m}{R}\sin(\omega t) + \omega C V_m \cos(\omega t - \theta)$

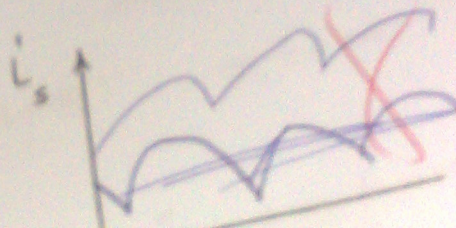
4. A full wave bridge rectifier with V_m = 200V, 50Hz, a resistance of 4Ω, an inductance of 20mH and a dc source of 100V. 3marks

(i) Is the current continuous or discontinuous? Why?

(ii) Sketch the waveform of the output voltage, output current and the supply current showing the exact values of the angles on the waveforms







① Voltage of $v(t) = 100 \sin(100\pi t)$ is applied to a ce... non-linear Load. The following current is given by:

$i(t) = 2 + 9\sin(100\pi t) - 12\cos(\pi t) + 5\sin(300\pi t)$ A.

① Find The rms value:

(i) $I_{rms} = \sqrt{2^2 + \frac{15^2}{2} + \frac{5^2}{2}} = 11.36$ A

(ii) $P.F = \frac{I_{rms_1}}{I_{rms}} = \frac{\frac{15}{\sqrt{2}}}{11.36} = 0.933\cos(+53) = 0.59$

(iii) $P = \frac{100}{\sqrt{2}} \times \frac{15}{\sqrt{2}} \cos(53) = 450$

$Q = \frac{100}{\sqrt{2}} \times \frac{15}{\sqrt{2}} \sin(53) = 600$

$VA = \frac{100}{\sqrt{2}} \cdot 11.36 = 803$

$D = \sqrt{803^2 - 600^2 - 450^2} = 286.9$ VA

(iv) $THD = \sqrt{\frac{1}{DF^2} - 1} = \sqrt{\frac{1}{0.933^2} - 1} = 0.383$

A single ϕ halfwave, RL Load and freewheeling diode, $V_m = 200V$

$R = 10\Omega$, $L = 0.05H$, $f = 50Hz$

n	V_n	X_n	Z_n	I_n	I_{rms}
0	628	0	10	6.28	6.28
1	100	15.7	18.6	5.376	3.8
2	42.4	31.4	~~40.887~~ 32.45	1.287	0.91

$I_{rms} = \sqrt{6.28^2 + 3.8^2 + 0.91^2}$

$= 7.4$

$7.4^2 \times 10 = 0.547$ W

3. A single ϕ half wave rectifier with resistive load and a smoothing capacitor

$V_m = 200, R = 1K\Omega, C = 100\mu F, f = 50Hz$

$\theta = \pi - \tan^{-1} \omega RC$

$= 91.72$

$\alpha = 56°$

$\Delta V = V_m (1 - \sin\alpha) = 200(1 - \sin\alpha)$

$= \boxed{34.13\ V}$

4. full wave bridge rectifier with $V_m = 200\ V$, $50Hz$, $R = 4$ inductance 20mH, dc source $= 100V$

(i) $\sin\alpha = \frac{E}{V_m} = \frac{100}{200}$

$\alpha = 30°$

$\beta = 190°$

$\frac{\omega L}{R} = 1.57$

2013

static Induction Thyristor: slide M1

Light - Activated Silicon :