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15/ENG05/006
MCT 510
Assignment 3

1) Prove that Ripple factor [R.F] = $[F.F^2 - 1]^{0.5}$

Ripple factor = $\frac{\text{RMS value of the AC voltage (input)}}{\text{D.C voltage (output of rectifier)}}$

$r.f = V_{rms}/V_{dc}$

$V_{rms} = \sqrt{V_{rms}^2 - V_{d.c}^2}$

$r.f = \sqrt{\left(\frac{V_{rms}}{V_{d.c}}\right)^2 - 1}$

Recall $F.F = V_{rms}/V_{dc}$

$r.f = \sqrt{F.F^2 - 1}$

$R.F = [F.F^2 - 1]^{0.5}$

2) Assuming $R.f = 10\Omega$

$R_{total} = R + R_f = 50 + 10 = 60\Omega$

i) $I_{dc} = \frac{1}{T}\int_0^{\pi} I_m \sin\omega t \, d(\omega t)$

$= \frac{1}{2\pi}\int_0^{\pi} I_m \sin\omega t \, d(\omega t)$

$= \frac{I_m}{2\pi}[-\cos\omega t]_0^{\pi}$

$= \frac{I_m}{2\pi}[-\cos\pi - [-\cos 0]]$

$= \frac{I_m}{2\pi}[-[-1] - [-1]]$ where $\pi = 180$

$I_m = V_m/R$; $V_m = 110v$

$\frac{V_m[2]}{2\pi R} = \frac{V_m}{\pi R} = \frac{110}{\pi \times 60}$

$I_{dc} = 0.5835A$

ii) $V_{dc} = I_{dc} \times R_t$ where $R_T = R + R_f$

$= 0.5835 \times (50 + 10)$

$= 35.01V$

5) $I_{rms} = \left[\frac{1}{T}\int_0^{\pi} V_m^2 \sin^2 \omega t \, d(\omega t)\right]^{0.5}$

$I_{rms} = V_m/(R+R_f)$

$= \left[\frac{V_m^2}{2\pi(R+R_f)}\int_0^{\pi} \sin^2 \omega t \, d(\omega t)\right]^{0.5}$

Recall $\sin^2\theta = \frac{1-\cos 2\theta}{2}$

$= \left[\frac{V_m^2}{2\pi(R+R_f)}\int_0^{\pi} \left(\frac{1-\cos 2\omega t}{2}\right) d(\omega t)\right]^{0.5}$

$= \left[\frac{V_m^2}{2\pi(R+R_f)}\int_0^{\pi} \frac{d(\omega t) - \cos 2\omega t \, d(\omega t)}{2}\right]^{0.5}$

$= \frac{V_m^2}{4\pi(R+R_f)}\left[\left[d\omega t\right]_0^{\pi} - \frac{\sin 2\omega t}{2}\right]_0^{\pi}$

$= \frac{V_m^2}{4\pi(R+R_f)}\left[\pi - 0\right] = \left[\frac{\sin 2\pi}{2} - \frac{\sin 2(0)}{2}\right]^{0.5}$

$= \left[\frac{V_m^2}{4\pi(R+R_f)}[\pi]\right]^{0.5}$

$= V_m/2(R+R_f)$

$= \frac{110}{2(50+10)} = 0.917A.$

4 $V_{rms} = I_{rms} \times (R+R_f)$

$= 0.917 \times (60+10)$

$= 55\,V$

5 $P_{dc} = V_{dc} \times I_{dc}$

$= 35.01 \times 0.5825$

$= 20.43\,W$

6 $P_{ac} = V_{rms} \times I_{rms}$

$= 55 \times 0.917$

$= 50.4\,W$

7. Efficiency $= \frac{P_{dc}}{P_{ac}} = \frac{20.43}{50.4} = 0.405\,\%$

8. $F.F = \frac{V_{rms}}{V_{dc}} = \frac{55}{35.01} = 1.57$

R.F = $[f.f^2 - 1]^{0.5}$

= $[1.591^2 - 1]^{0.5}$

= 1.212

7 TUF = $2\sqrt{2} / \pi^2$ = 0.287

9 PIV = V_m = 110V

10 C.F = $2V_m / V_m$ = 2.