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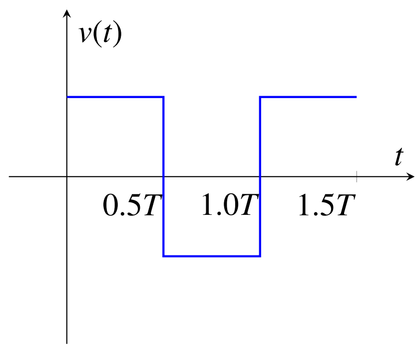
EE22BTECH11008 - Annapureddy Siva Meenakshi*

Q: Consider an ideal full-bridge single-phase DC-AC inverter with a DC bus voltage magnitude of $1000V$. The inverter output voltage $v(t)$ shown below is obtained when diagonal switches of the inverter are switched with 50% duty cycle. The inverter feeds a load with a sinusoidal current given by $i(t) = 10\sin(\omega t - \frac{\pi}{3})$ A, where $\omega = \frac{2\pi}{T}$. The active power, in watts, delivered to the load is __.[Gate2022-EE-58]



Solution:

Variable	Description	Value
V_{dc}	input DC voltage	$1000V$
$i(t)$	output current	$\sin(\omega t - \frac{\pi}{3})$
$v(t)$	Output voltage	given
ω	Frequency	$\frac{2\pi}{T}$
v_0^{rms}	RMS output voltage at the fundamental frequency	none
i_{rms}	RMS output current at the fundamental frequency	none
$v_0(t)$	output voltage at the fundamental frequency	none
ϕ	phase difference between $v_0(t)$ and $i(t)$	none
i_0	amplitude of output current	1
P	active power delivered	none

TABLE 0: Input parameters

The Fourier series expansion of the given voltage $v(t)$ is,

$$v(t) = \sum_{n=1,3,5,...}^{\infty} \frac{4V_{dc}}{n\pi}\sin(n\omega t) \tag{1}$$

$$v_0(t) = \frac{4V_{dc}}{\pi}\sin(\omega t) \tag{2}$$

$$\therefore \quad \phi = \frac{\pi}{3} \tag{3}$$

$$v_0^{rms} = \frac{4V_{dc}}{\pi\sqrt{2}} \tag{4}$$

$$= \frac{40000}{\pi\sqrt{2}} \tag{5}$$

$$i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{1}{\sqrt{2}} \tag{6}$$

Active power delivered to load in Watts is given by,

$$
\begin{aligned}
P &= v_0^{\mathrm{rms}} \times i_{\mathrm{rms}} \times \cos\phi && (7)\\
&= \frac{40000}{\pi\sqrt{2}} \times \frac{1}{\sqrt{2}} \times \cos\frac{\pi}{3} && (8)\\
&\approx 3183 && (9)
\end{aligned}
$$