

Hard

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Gujarat Public Service Commission / Assistant Engineer (Electrical)

A single-phase full converter is connected to 230 V, 50 Hz. The load is $R = 10\ \Omega$ with a very large inductance. For $\alpha = 30^\circ$, verify. 1. Average output voltage is approximately

A

1 and 2 only

B

2 and 3 only

C

1, 2 and 3

Correct

D

1 and 3 only

Correct Answer: C

Full Detailed Explanation

Correct Answer: C - 1, 2 and 3 Quick Concept Explanation Firing angle controls average DC voltage; the AC-side current is non-sinusoidal and its fundamental is displaced approximately by α . $V_{dc} = (2 \times 230 / \sqrt{2}) \cos 30^\circ = 179.3\text{ V}$. With $R=10\ \Omega$ and highly inductive continuous current, $I_d = 17.93\text{ A}$. Key relation: 1 : $V_{dc} = (2V_m / \sqrt{2}) \cos \alpha = 0.9V_{rms} \cos \alpha$; 3 : $V_{dc} = 1.35V_{LL} \cos \alpha$. Exam focus: Large load inductance $\rightarrow$ nearly constant DC current. Common trap: Distinguish displacement factor $\cos \alpha$ from total power factor including distortion. Statement-wise Verification Statement 1 - Correct. Average output voltage is approximately 179.3 V. $V_{dc} = (2 \times 230 / \sqrt{2}) \cos 30^\circ = 179.3\text{ V}$. Statement 2 - Correct. The RMS value of the input current is 17.93 A. With $R=10\ \Omega$ and highly inductive continuous current, $I_d = 17.93\text{ A}$. Statement 3 - Correct. The fundamental power factor is 0.866. The fundamental displacement factor is $\cos 30^\circ = 0.866$. Core Concept A fully controlled bridge feeding a highly inductive load operates with nearly continuous DC current. Firing angle controls average DC voltage; the AC-side current is non-sinusoidal and its fundamental is displaced approximately by α . In three-phase bridges each thyristor conducts for 120 electrical degrees under continuous current. Formula / Key Relationship 1 : $V_{dc} = (2V_m / \sqrt{2}) \cos \alpha = 0.9V_{rms} \cos \alpha$; 3 : $V_{dc} = 1.35V_{LL} \cos \alpha$. Step-by-Step