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AC power, generator and transformer

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Average power	P = V rms I rms cos(phi) = I rms^2 R Valid when: sinusoidal steady state, rms values; I^2 R form for the resistance R in series	W
Power factor	cos(phi) = R/Z Valid when: series R, L, C circuit in sinusoidal steady state	dimensionless
Apparent power	S = V rms I rms Valid when: rms voltage and rms current of any ac circuit	VA
Wattless current	I sin(phi) = I X/Z Valid when: series circuit with net reactance X and impedance Z, sinusoidal steady state	A
Power triangle	S^2 = P^2 + Q^2; Q = V I sin(phi) Valid when: sinusoidal steady state, rms values; phi is the phase angle	VA (W, var)
AC generator emf	e = N B A w sin(w t); E0 = N B A w Valid when: coil of N turns rotating uniformly in uniform B, axis perpendicular to B, t=0 at zero emf	V
Angular speed from rpm	w = 2 pi (rpm)/60 Valid when: rpm to rad/s, any uniform rotation	rad/s
Ideal transformer voltages	Vs/Vp = Ns/Np Valid when: ideal transformer: no flux leakage, no losses	dimensionless
Ideal transformer currents	Ip/Is = Ns/Np; Vp Ip = Vs Is Valid when: ideal transformer; real transformers have Ip Vp greater than Vs Is	dimensionless
Efficiency	eta = Vs Is/(Vp Ip) Valid when: any transformer, using rms power in and out	dimensionless
Line loss	I^2 R = P^2 R/V^2 Valid when: line current I = P/V at unity power factor, line resistance R	W

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/electromagnetic-induction-and-alternating-currents/ac-power-generator-

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