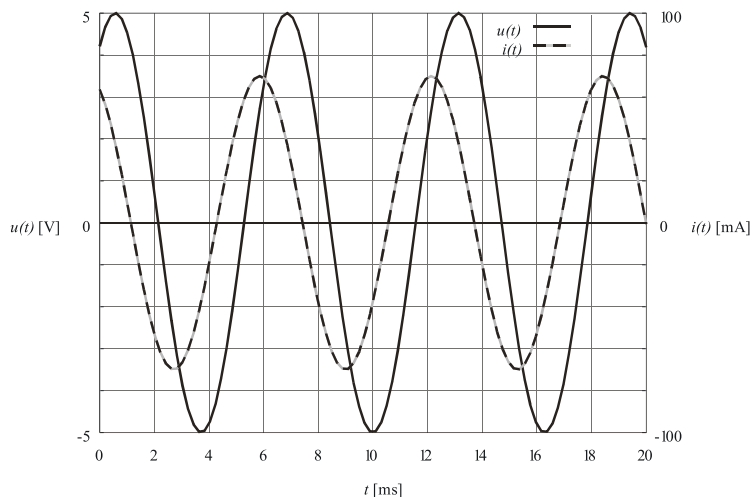


AC CIRCUITS

BASIC PROBLEMS

1. How long does it take for an ac signal with frequency 25 Hz to drop from the maximum to one half of the maximum?
2. An ac motor runs on ac voltage with a frequency of 25 Hz and an amplitude of 12 V. Its impedance is $450\ \Omega$. The current lags behind the voltage by 15 ms. Calculate the current's amplitude and the phase shift.
3. Another ac motor is labelled as "230 V/0.3 A/50 W". What do these numbers stand for? Calculate the motor's power factor and phase shift.
4. Using the diagram below, answer the following questions:



- a) Determine the amplitude and the period of the voltage signal (solid line) and of the current signal (dashed line). Calculate the rms values, frequency and angular frequency.
 - b) Determine the circuit's impedance and phase shift and calculate the effective power.
5. For which frequency do a 330 nF capacitor and a 24 mH inductor have the same reactance?
 6. Calculate the current amplitude in an ac circuit with a capacitor 22 μ F on a voltage with frequency 50 Hz and amplitude 25 V. Draw the corresponding phasor diagram.
 7. The sound control of a hifi system can be realised by series wiring a capacitor and a resistor. Which partial voltage favours the low frequencies?
 8. A 33 nF capacitor and a 22 k Ω resistor are connected in series to a voltage supply. The phase shift between voltage and current is $-\pi/4$. Calculate the frequency of the voltage signal.
 9. A coil with inductance 220 mH, a capacitor with capacitance 150 μ F and a resistor with resistance 22 Ω are connected in parallel to a voltage signal with frequency 50 Hz. Calculate the impedance and the phase shift.
 10. The voltage of high voltage power lines is increased from 230 kV to 380 kV. By how many percents are the transmission losses reduced?

ADDITIONAL PROBLEMS

11. A light emitting diode (LED) runs on an ac voltage with amplitude 7 V. The current can flow through the diode only in one direction and only when the voltage is greater than the threshold value 2.5 V. Using a phasor diagram, determine the fraction of a period during which the LED emits light.
12. Graph and discuss the impedance vs. frequency diagram for a parallel ac circuit. Why is this circuit often called a *band rejection filter*?
13. Derive a formal expression for the *resonance frequency* of an ac series circuit, i.e. the frequency for which the impedance has a minimum value. Calculate the resonance frequency for a series circuit with inductance 3.3 mH, resistance 32 Ω and capacitance 68 pF. Graph the impedance vs. frequency diagram and compare the frequency at the minimum with the calculated value.

SOLUTIONS: TO BASIC PROBLEMS 1. 6.7 ms; 2.27 mA, 1.2 rad; 3. 0.72, 43.5°; 4. 5 V, 6.2 ms, 70 mA, 3.5 V, 50 mA, 160 Hz, 1'000 s⁻¹; 70 Ω , 1.0 rad = 58°; 5. 1.8 kHz; 6. 170 mA; 8. 220 Hz; 9. 18 Ω ; 10. - 63 %