The Circuits 2 “It is not possible to have any more fun than this because if I was trying to have any more fun than this, I’d probably puke, and then that wouldn’t be very fun” problem set.

First problem: A 1 volt source drives a 100 ohm resistor in series with a 1 microfarad capacitor and a 20 millihenry choke with 30 ohms internal resistance. Determine the resonance frequency, the system bandwidth and Q, and the minimum circuit impedance.

Second problem: A class A amplifier has an AC Re value of 100 ohms and its r’e is negligible. In the collector are a 100 nF cap in parallel with a 100 uH coil which has 2 ohms of internal resistance. The Zin of the following stage is 5k ohms. Determine the frequency of maximum gain, the maximum gain, and the bandwidth of the amplifier.

Third problem: A 208 3-phase delta connected generator feeds a Y connected load consisting of 3 legs of 10 ohms in series with 4 ohms of inductive reactance. Find the voltage across each load leg, the current through the wires connecting the load to to the generator, and the apparent and real powers drawn by the load.

Answers

First problem: A 1 volt source drives a 100 ohm resistor in series with a 1 microfarad capacitor and a 20 millihenry choke with 30 ohms internal resistance. Determine the resonance frequency, the system bandwidth and Q, and the minimum circuit impedance.

f_0= 1.125 kHz
X_L= 141.4 ohms
Q= 141.4/(100+30) = 1.09
Min Z = 130 ohms
BW=1.125 kHz/1.09 = 1.03 kHz

Second problem: A class A amplifier has an AC Re value of 100 ohms and its r'e is negligible. In the collector are a 100 nF cap in parallel with a 100 uH coil which has 2 ohms of internal resistance. The Zin of the following stage is 5k ohms. Determine the frequency of maximum gain, the maximum gain, and the bandwidth of the amplifier.

Max gain occurs at resonance because that's where max load impedance occurs.
f_0= 50.3 kHz
X_L= 31.6 ohms
Q_{coil}= 31.6/2 = 15.8
Parallel equivalent of coil R = 2 *15.8^2 = 500 ohms
Effective load = 500 || 5 k = 455 ohms
A_v = 455/100 = 4.55
System Q = 455/31.6 = 14.4
BW=50.3 kHz/14.4 = 3.5 kHz

Third problem: A 208 3-phase delta connected generator feeds a Y connected load consisting of 3 legs of 10 ohms in series with 4 ohms of inductive reactance. Find the voltage across each load leg, the current through the wires connecting the load to to the generator, and the apparent and real powers drawn by the load.

Load voltage = 120
i = 120/(10+j4) = 11.14 amps magnitude, angle of -21.8 degrees
S = 120 volts * 11.14 amps = 1337 VA per leg, 4011 VA total
P = S cos θ = 1337 cos -21.8 = 1241 watts per leg, 3724 watts total