EE 411 Homework 1 Solutions

1)

a-)

octave:1> c=68e-12;

octave:2> l=400e-9;

octave:3> r=5e3;

octave:4> fres=(1/sqrt(l*c))/(2*pi)

fres = 3.0517e+07 = **30.517 MHz**

b-)

i. At resonance impedance of the inductor is equal to Rp = 5K

ii. octave:10> imp_c=1/(j*2*pi*fres*0.5*c)

imp_c = 0.00000 - 153.39300i

octave:11> imp_l=j*2*pi*fres*0.5*l

imp_l = 0.00000 + 38.34825i

octave:12> 1/(power(imp_c,-1)+power(imp_l,-1)+power(5000,-1))

ans = 0.52282 + 51.12565i

iii. octave:14> imp_c=1/(j*2*pi*fres*2*c)

imp_c = 0.00000 - 38.34825i

octave:15> imp_l=j*2*pi*fres*2*l

imp_l = 0.00000 + 153.39300i

octave:16> 1/(power(imp_c,-1)+power(imp_l,-1)+power(5000,-1))

ans = 0.52282 – 51.12565i

iv. octave:23> imp=0.52282 + 51.12565i

imp = 0.52282 + 51.12565i

octave:24> eff_inductance=imag(imp)/(2*pi*fres*0.5)

eff_inductance = 5.3328e-07 = **533.28 nH at @ f_resonance/2**

octave:25> imp=0.52282-j*51.12565

imp = 0.52282 - 51.12565i

octave:26> eff_inductance=imag(imp)/(2*pi*fres*2)

eff_inductance = -1.3332e-07 **= -133 nH @ 2*f_resonance**

Negative inductance is rather meaningless calculating the effective capacitance

eff_cap=1/(2*pi*2*fres*abs(imag(imp)))

eff_cap = 5.1005e-11 = **50 pF at twice the resonance frequency the inductor acts as a capacitor.**

2)

a-)

octave:1> c=2e-9;

octave:2> l=0.7e-9;

octave:3> r=25e-3;

octave:4> fres=(1/sqrt(l*c))/(2*pi)

fres = 1.3451e+08 = **134.51 MHz**

b-)

i. at resonance the impedance of the capacitor is equal to 25 mΩ

ii. octave:5> imp_l=j*2*pi*fres*0.5*l
imp_l = 0.00000 + 0.29580i
octave:6> imp_c=1/(j*2*pi*fres*0.5*c)
imp_c = 0.00000 - 1.18322i
octave:7> imp=imp_c+imp_l+r
imp = 0.025000 – 0.887412i

iii. octave:8> imp_c=1/(j*2*pi*fres*2*c)
imp_c = 0.00000 - 0.29580i
octave:9> imp_l=j*2*pi*fres*2*l
imp_l = 0.00000 + 1.18322i
octave:10> imp=imp_c+imp_l+r
imp = 0.025000 + 0.887412i

iv. octave:11> eff_inductance=imag(imp)/(2*pi*fres*2)
eff_inductance = 5.2500e-10 = **0.525 nH @ 2 *fres**
octave:22> imp=0.025-j*0.887412
imp = 0.025000 - 0.887412i
octave:23> 1/(2*pi*fres*0.5*abs(imag(imp)))
ans = 2.6667e-09 = **2.66 nF @ fres /2**