**ELECTRICAL AND ELECTRONIC TECHNOLOGY**

**Time: 40 mins**

**RCL PROBLEM SOLVING EXERCISES**

**NOTE: This worksheet follows from the power-point lesson on RCL Circuits. It is recommended that the following problem solving questions be attempted.**

**Instruction: The questions below involves problem solving exercises on RCL circuits. The estimated time for the completion of question 1 is 10minutes. Question 2 and 3 are allocated an estimated time of 15 minutes each.**

1. At a given frequency, a series AC circuit has an inductive reactance (XL) of 40Ω, a capacitive reactance (XC) of 80Ω and a resistance (R) of 30Ω. Calculate the
2. total impedance (ZT) of the circuit
3. magnitude of the phase angle of the circuit. (CXC EET 2019)

R

110 V

XL=180Ω

XC=150Ω

R = 50Ω

**FIG 1**.

For the circuit shown in fig 1 above calculate

1. Total impedance ZT
2. Total current IT
3. Voltage across R, XL,XC
4. Powerfactor
5. True power utilized by the circuit

R

R = 50Ω

XL=0.199H

XC= 26.52µf

240 Vac , 60HZ

**Fig 2**

For the circuit above in Fig 2., calculate the

1. total impedance, ZT
2. total current, IT
3. voltage across
4. R
5. XL
6. XC
7. power factor
8. circuit True power in watts

**RCL CIRCUITS SOLUTIONS**

1. (a) ZT = R2 + (XC – XL)2 ; R = 30Ω; XL =40Ω; XC =80Ω

ZT = 302 + (80 – 40)2 = 302 + (40)2  = 900 + 1600

**ZT = 2500 = 50Ω**

1. Phase angle of the circuit, cos ø = R/Z = 30/50 = 0.6

Therefore; **ø = cos-1 0.6 = 53.1°**

2.

R

110 V

XL=180Ω

XC=150Ω

R = 50Ω

**FIG 1**.

2. (a)

ZT = R2 + (XL - XC)2 ; R = 50Ω; XL =180Ω; XC =150Ω

ZT = 502 + (180 – 150)2 = 502 + (30)2  = 2500 + 900

**ZT = 3400 = 58Ω**

1. **IT = V/R = 110/58 = 1.9A**

**2. (**c) (i) VR = I x R = 1.9 x 50 = 95 V

(ii) VL = I x XL = 1.9 x 180 = 342V

1. VC = I x Xc = 1.9 x 150 = 285 V

(d) Power Factor (Cos **ø) = R/Z = 50/58 = 0.86**

(e) P = VxI x cos **ø = 110 x 1.9 x 0.86 = 180W**

OR

P = I2 x R = (1.9)2 x 50 = **180W**

3.

R

R = 50Ω

XL=0.199H

XC= 26.52µf

240 Vac , 60HZ

**Fig 2**

1. XL = 2ПfL = 2 x 3.142 x 60 x 0.199 = 75Ω

XC = 1/2ПFC = 1/ 2 x 3.142 x 60 x 26.52 x10-6 = 100Ω

R = 50Ω(a)

ZT = R2 + (XC – XL)2 ; R = 50Ω; XL =75Ω; XC =100Ω

ZT = 502 + (100 – 75)2 = 502 + (25)2  = 2500 + 625

**ZT = 3125 = 55.9Ω**

1. **IT = V/R = 240/55.9 = 4.29A**

(c)(i) VR = I x R = 4.29 x 50 = 214.5 V

(ii) VL = I x XL = 4.29 x 75 = 321.75V

(iii)VC = I x Xc = 4.29 x 100 = 429 V

(d)Power Factor (Cos **ø) = R/Z = 50/55.9 = 0.894**

(e) VxI x cos **ø = 240 x 4.29 x 0.894 = 920W**

OR

P = I2 x R = (4.29)2 x 50 = **920W**