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ECE522 - EXAM1

In [1]:
```
# Import Necessary Libraries
import numpy as np
import matplotlib.pyplot as plt
from scipy.optimize import fsolve
import electricpy as ep
from electricpy.constants import *

# Set Boolean Control for Report Style
debug = True
```

Problem II:

Repeat Parts B and C of Problem I for the situation where theparameter Lr/rr in the "slip calculator" is in error by +25%.

Comment on the effect on steady state performance of such "detuning" of the controller.

Since we know: $s = \frac{\omega_{es} - \omega_r}{\omega_{es}}$, we can manipulate the equation into the form: $(\omega_{es} - \omega_r) = s \cdot \omega_{es}$. In this form, we can substitute it into our equations to solve.

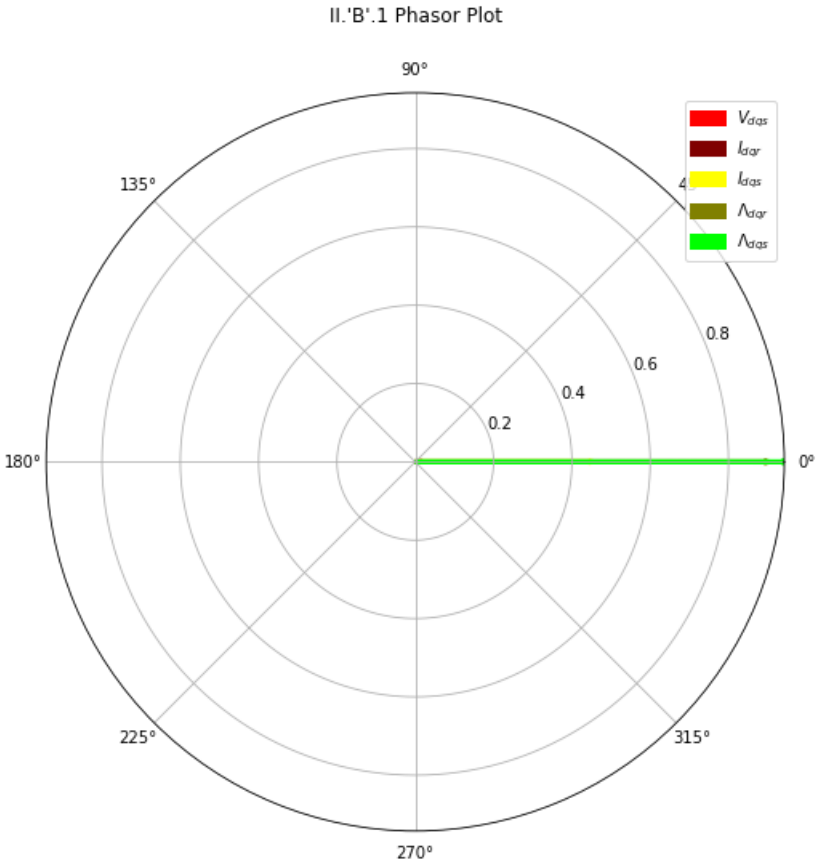
Part 'B' (since we're only repeating parts B and C of problem 1):

In [4]:

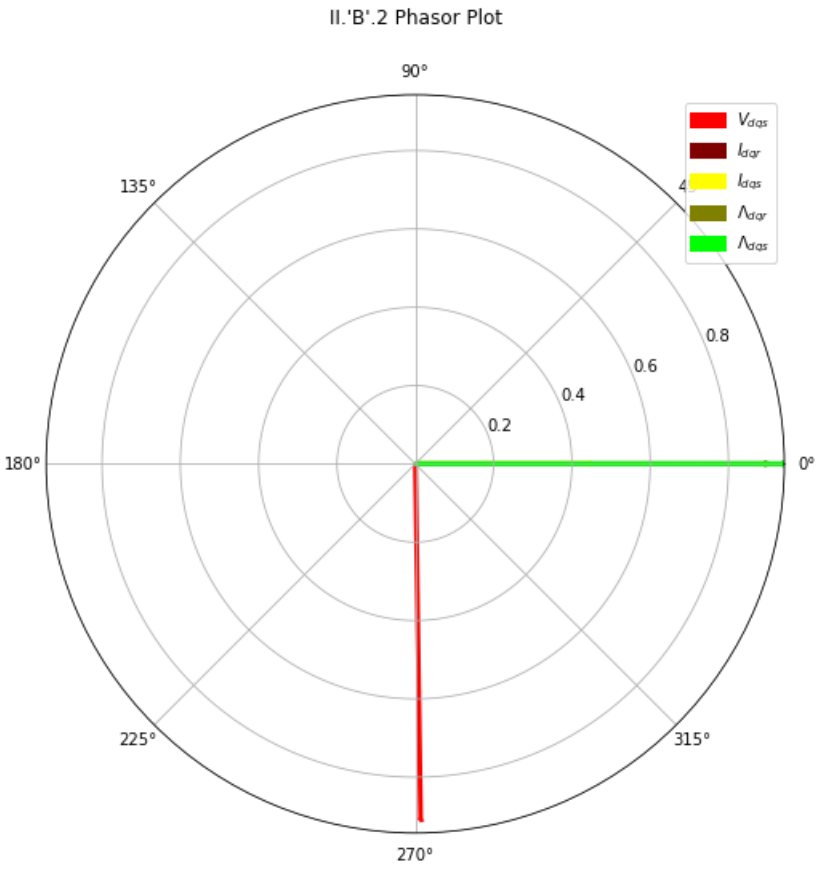
```
# Define Provided Machine Parameters
rs = 0.03 #pu
LLs = 0.1 #pu
Lm = 2.0 #pu
LLr = 0.1 #pu
rr = 0.03 #pu

# Define Rated Criteria
VdqsMag = 1
wes = 1
Tem = 0

# Calculate Additional Inductance Terms
Ls = LLs + Lm
Lr = LLr + Lm

#####################################################
# Read Data Calculated from Problem 1
with open("constants.txt",'r') as file:
    s_rated = float(file.readline())
    w_rated = float(file.readline())
    lamdr_rated = float(file.readline())
print("S-rated:",s_rated,"\tw-rated:",w_rated,"\tLambda-rated:",lamdr_rated)
#####################################################

texlabels = [
    "$V_{dqs}$",
    "$I_{dqr}$",
    "$I_{dqs}$",
    "$\\Lambda_{dqr}$",
    "$\\Lambda_{dqs}$",
]
labels = [
    "Vdqs:",
    "Idqr:",
    "Idqs:",
    "λdqr:",
    "λdqs:",
]

#########################################################################
# "B".1)
wr = 0.0
LAMdr = lamdr_rated

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
print("w-slip:",wslip,"\tw-es",wes)
clist *= ep.phs(-np.angle(clist[3],deg=True))
ep.phasorplot(clist,"II.'B'.1 Phasor Plot",texlabels,filename="II-B-1",size=8,linewidth=3,plot=debug

#########################################################################
# "B".2)
wr = w_rated
LAMdr = lamdr_rated

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
print("w-slip:",wslip,"\tw-es",wes)
clist *= ep.phs(-np.angle(clist[3],deg=True))
ep.phasorplot(clist,"II.'B'.2 Phasor Plot",texlabels,filename="II-B-2",size=8,linewidth=3,plot=debug

#########################################################################
# "B".3)
wr = 2*w_rated
LAMdr = lamdr_rated/2

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
```

```
72 clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
73 print("w-slip:",wslip,"\tw-es",wes)
74 clist *= ep.phs(-np.angle(clist[3],deg=True))
75 ep.phasorplot(clist,"II.'B'.3 Phasor Plot",texlabels,filename="II-B-3",size=8,linewidth=3,plot=debug
```

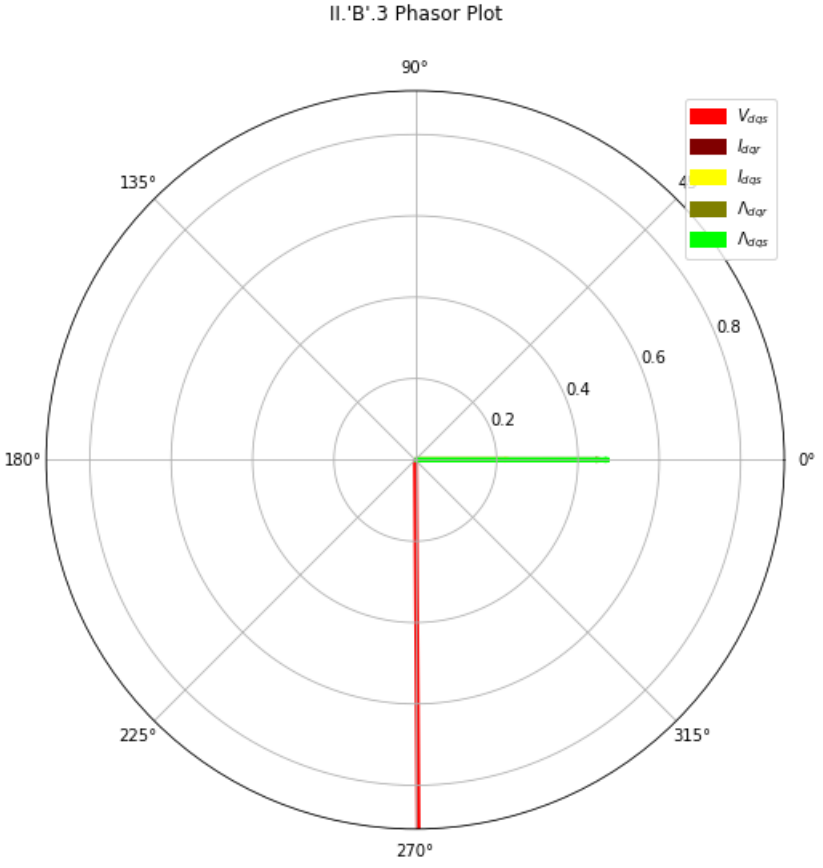
```
S-rated: 0.03723079497495241    ω-rated: 0.9627692050250476    Lambda-rated: 0.8976550377456242
w-slip: 0.0     w-es 0.0
```




```
w-slip: 0.0     w-es 0.9627692050250476
```




```
w-slip: 0.0     w-es 1.9255384100500952
```



Part 'C' (since we're only repeating parts B and C of problem 1):

Comments and Analysis:

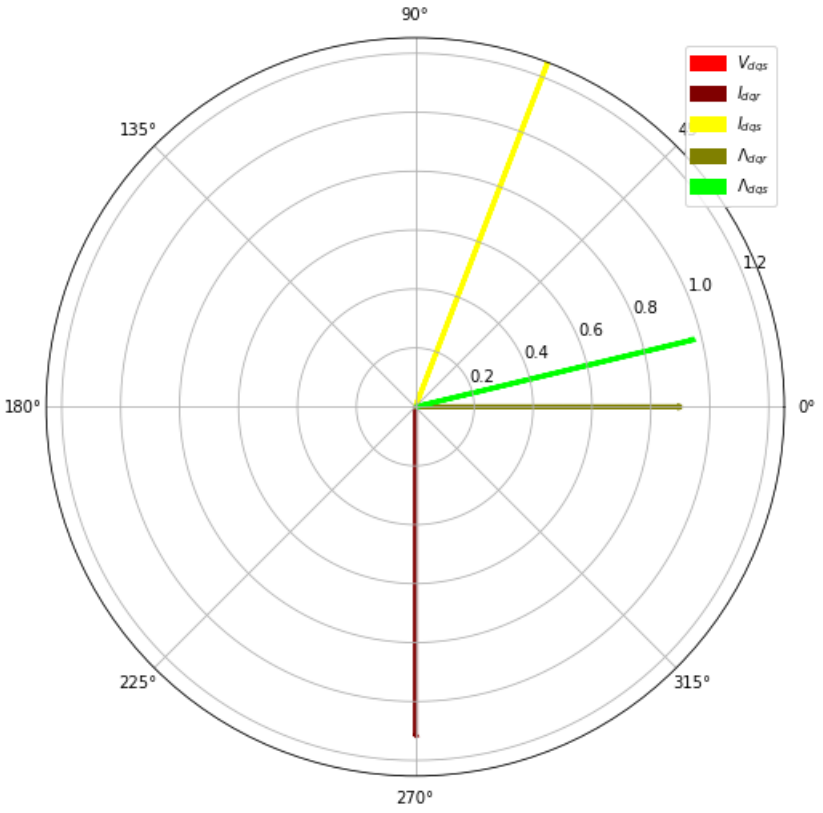
From comparison, it seems clear that these results are not too dissimilar from those found in the previous problem (problem I). Perhaps the only truly notable difference is that magnitude difference between the results. Angle differences and general relations between the vectors appear to be largely the same between the Problem I results and these Problem II results.

In [6]:

```
########################################################################
# "C".1)
Tem = 1.0
wr = 0.0
LAMdr = lamdr_rated

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
print("w-slip:",wslip,"\tw-es",wes)
clist *= ep.phs(-np.angle(clist[3],deg=True))
ep.phasorplot(clist,"II.'C'.1 Phasor Plot",texlabels,filename="II-C-1",size=8,linewidth=3,plot=debug

########################################################################
# "C".2)
Tem = 1.0
wr = w_rated
LAMdr = lamdr_rated

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
print("w-slip:",wslip,"\tw-es",wes)
clist *= ep.phs(-np.angle(clist[3],deg=True))
ep.phasorplot(clist,"II.'C'.2 Phasor Plot",texlabels,filename="II-C-2",size=8,linewidth=3,plot=debug

########################################################################
# "C".3)
Tem = 0.5
wr = 2*w_rated
LAMdr = lamdr_rated/2

# Generate Phasor Plot
Vdqs,Idqr,Idqs,LAMdqr,LAMdqs,wslip,wes = ep.imfoc_control(Tem,LAMdr,wr,rr,rs,Lm,LLr,LLs,s_err=0.25)
clist = np.array([Vdqs,Idqr,Idqs,LAMdqr,LAMdqs])
print("w-slip:",wslip,"\tw-es",wes)
clist *= ep.phs(-np.angle(clist[3],deg=True))
ep.phasorplot(clist,"II.'C'.3 Phasor Plot",texlabels,filename="II-C-3",size=8,linewidth=3,plot=debug
```

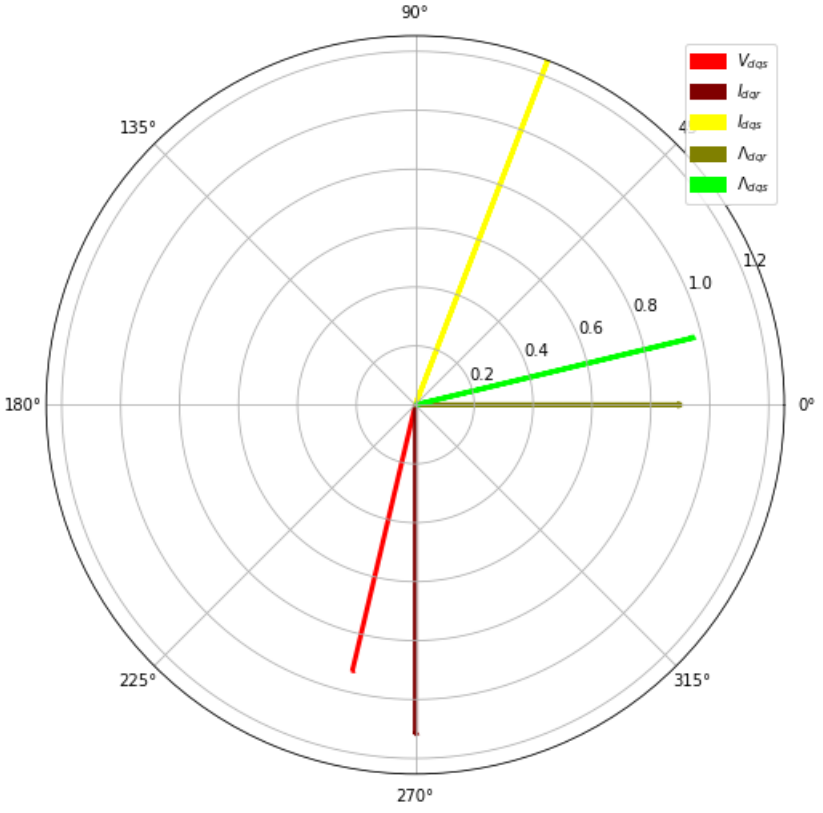
```
w-slip: 0.029784635979819975    w-es 0.029784635979819975
```

II.'C'.1 Phasor Plot

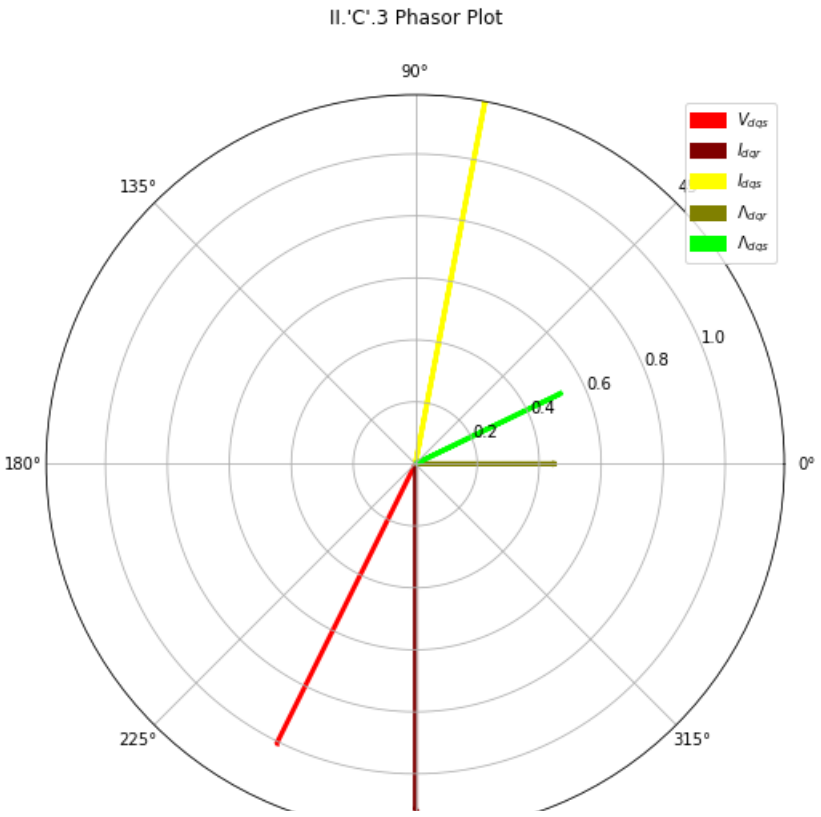


w-slip: 0.029784635979819975 w-es 0.9925538410048675

II.'C'.2 Phasor Plot



w-slip: 0.05956927195963995 w-es 1.985107682009735



Comments:

We see the same behavior as the first problem!

In [ ]:
```
1
```