ME 352-A
Lab 5: Static and Dynamic Balancing of Rotor

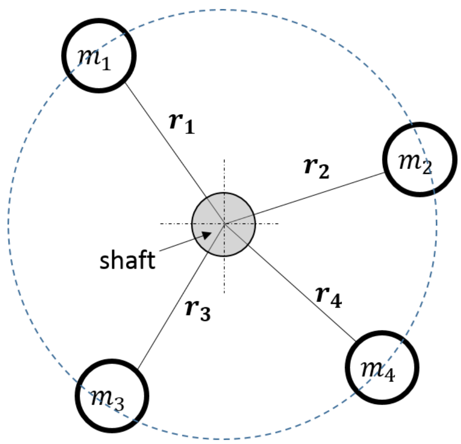
Part A: Static Balancing

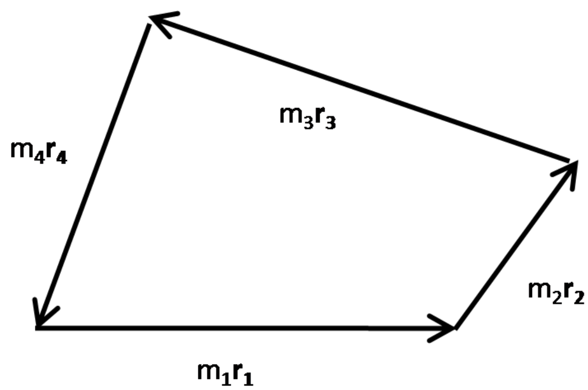
Concept: When rotor is statically balanced, then the center of mass lies on the axis of rotation

A Crosscheck: Rotate the shaft to any angular position and leave it. If it is statically balanced then the shaft will retain its position.

Procedure:

a) You are provided with 4 different masses(in from of bars) and thus "the shaft + 4 masses" constitutes your system
b) As of now you assume that the center of mass of the bars is at equidistant from the axis of rotation.
c)





d) Orient the masses on the shaft in such a way that :
   a. center of mass = $\sum m_i \boldsymbol{r_i} = \mathbf{0}$
e) For that randomly orient masses m_1 and m_2 (at θ_1 *and* θ_2) and then analytically solve for getting orientation of m_3 and m_4 (i.e. θ_3 *and* θ_4)
f) Manually orient m3 and m4 at calculated angles θ_3 *and* θ_4 and then see if there is unbalance (there will be most probably).
g) You then need to finely adjust the orientations of any two masses to make the system statically stable.

Report:

- Calculations (get signed by TA in lab)
- Report the analytical(calculated) and final(actual) orientations (get signed by TA in lab)
- Report the reason for doing these "fine adjustments" after coming up with analytical values
- Report the sources of error

Caution: Remove the belt from the pulley attached to the shaft; ensure smoothness in rotating the shaft
Note: Bring geometric set and calculator in lab

("Part B" on next page)

Part B: Dynamic Balancing:

Concept: The rotor is dynamically balanced if net moment produced is zero

A crosscheck: When the rotor is dynamically balanced, the system will *not* undergo vibration when the rotor is rotated.

Procedure:

a) Mount the belt on the pulley of the shaft
b) Current state is that your system is "statically balanced" (from previous part)
c) Considering the bearing near the belt as your origin, you need to come up with the axial position of masses on the shaft "a_i" such that:
    a. Net Moment = $\sum \boldsymbol{a_i} \times m_i \boldsymbol{r_i} = 0$
d) The procedure from this step onwards is *analogous* to that of Part A from steps "e" to "g" where the lengths of side of polygon is "$a_i m_i r_i$" instead of "$m_i r_i$". To check the unbalance, rotate the rotor at various "rpms".

Report:

- Calculations (get signed by TA in lab)
- Report the theoretical(calculated) and final(actual) axial position "a_i" (get signed by TA in lab)
- Report the reason for doing these "fine adjustments" after coming up with analytical values
- Report the sources of error

Caution: Increase the rpm of motor gradually from zero

--ENJOY THE LAB---