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

Part A: Static Balancing

Concept: When the rotor is statically balanced, the centre of mass lies on the axis of rotation.

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 four different masses (in the form of bars) and thus "the shaft + 4 masses" constitutes your system.
b) As of now, you assume that the centres of masses of the bars are equidistant from the axis of rotation.

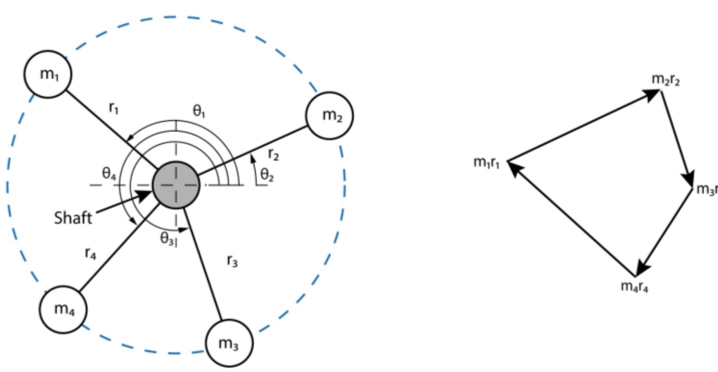

Figure: Orientation of masses around the shaft and their vector diagram

c) The task is to orient the masses on the shaft in such a way that the effective centre of mass lies at origin. The system follows $\sum \overrightarrow{m_i}\overrightarrow{r_i} = 0$.
d) Randomly orient the masses m_1 and m_2 (at θ_1 and θ_2) and then analytically solve for getting the orientation of the masses m_3 and m_4 (i.e. θ_3 and θ_4).
e) Manually orient m_3 and m_4 at calculated angles θ_3 and θ_4 and then see if there is an unbalance (there will most probably be).
f) Then you need to finely adjust the orientations of any two masses to make the system statically stable.

Report:

- Calculations (get it signed by TAs in the lab).
- Report the calculated and final (actual) orientations (get it signed by TAs in the lab).
- Report the reason for making these "fine adjustments" after coming up with analytical values.
- Report the possible sources of errors.

Caution: Remove the belt from the pulley attached to the shaft; ensure smoothness in rotating the shaft.

Note: Bring your own geometric set and calculator.

Part B: Dynamic Balancing

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

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) The current state is that the system is "statically balanced" (from previous part).
c) Considering the bearing near the belt as origin, you need to come up with the axial positions of masses on the shaft "a_i" such that the net moment satisfies $\sum \overrightarrow{a_i} \times \overrightarrow{m_i}\,\overrightarrow{r_i} = 0$.
d) The procedure from this step onwards is similar to that of Part A from steps "d" to "f" where the lengths of the sides of the polygon "$a_i m_i r_i$" instead of "$m_i r_i$". To check the unbalance, rotate the rotor at various rpms.

Report:

- Calculations (get it signed by TAs in the lab).
- Report the calculated and final (actual) axial position "a_i" (get it signed by TAs in the lab).
- Report the reason for making these fine adjustments after coming up with analytical values.
- Report the possible sources of errors.

Caution: Gradually increase the rpm of motor from zero.

--ENJOY THE LAB--