① a/ $$J_{td} = J_{d_1}\frac{\omega_1^2}{\omega_1^2} + (J_{d_2}+J_{z_2})\frac{\omega_2^2}{\omega_1^2} + (J_{z_3}+J_{z_3}')\frac{\omega_3^2}{\omega_1^2} + (J_{z_4}+J_{c_4})\frac{\omega_4^2}{\omega_1^2} + (J_{z_5}+J_{c_5})\frac{\omega_5^2}{\omega_1^2}$$

với $$\frac{\omega_2}{\omega_1} = \frac{d_1}{d_2} = \frac{1}{3}\ ;\ \frac{\omega_3}{\omega_1} = \frac{\omega_3}{\omega_2}\cdot\frac{\omega_2}{\omega_1} = \frac{z_2}{z_3}\cdot\frac{1}{3} = \frac{1}{5}\ ;$$

$$\frac{\omega_4}{\omega_1} = \frac{\omega_4}{\omega_3}\cdot\frac{\omega_3}{\omega_1} = \frac{z_3'}{z_4}\cdot\frac{1}{5} = \frac{2}{15}\ ;\ \frac{\omega_5}{\omega_1} = \frac{\omega_5}{\omega_3}\cdot\frac{\omega_3}{\omega_1} = \frac{z_3'}{z_5}\cdot\frac{1}{5} = \frac{2}{15}$$

$\Rightarrow J_{td} = 0{,}08\ kg\ m^2$. (1đ)

b/ Bình ổn $\Rightarrow \int_0^T M_đ\, d\varphi = \int_0^T (-M_c)\, d\varphi \Rightarrow ? = 10\,Nm$ (1đ)

c/

| $\varphi_1$ | $\varphi_2$ | $\left\lvert\int_{\varphi_1}^{\varphi_2}(M_c+M_đ)\,d\varphi\right\rvert$ |
|---|---|---|
| 0 | 2T/10 | |
| 0 | 4T/10 | |
| 0 | 6T/10 | $8\pi = 4T > 0$ max |
| 0 | 8T/10 | 0 |
| 2T/10 | 4T/10 | |
| 2T/10 | 6T/10 | |
| 2T/10 | 8T/10 | |
| 4T/10 | 6T/10 | $8\pi = 4T > 0$ max |
| 4T/10 | 8T/10 | |
| 6T/10 | 8T/10 | |

$\Rightarrow$ $\varphi_{min} = 0$ hay $\varphi_{min} = \frac{4T}{10} = \frac{4\pi}{5}$

$\varphi_{max} = \frac{6T}{10} = \frac{6\pi}{5}$

(1 đ)

d/ $$\omega_{max} = \sqrt{\omega_{min}^2 + \frac{2}{J_{td}}\int_{\varphi_{min}}^{\varphi_{max}}(M_c+M_đ)\,d\varphi}$$

$$\Rightarrow \omega_{max}^2 - \omega_{min}^2 = \frac{2}{J_{td}}\int_{\varphi_{min}}^{\varphi_{max}}(M_c+M_đ)\,d\varphi = \frac{2}{0{,}08}\cdot 8\pi$$

$\Rightarrow \omega_{max}^2 - \omega_{min}^2 = 200\pi$

max $\frac{\omega_{max}+\omega_{min}}{2} = \omega_{tb} = 150\ rad/s$

$\Rightarrow \omega_{max} - \omega_{min} = \frac{2\pi}{3}$ rad

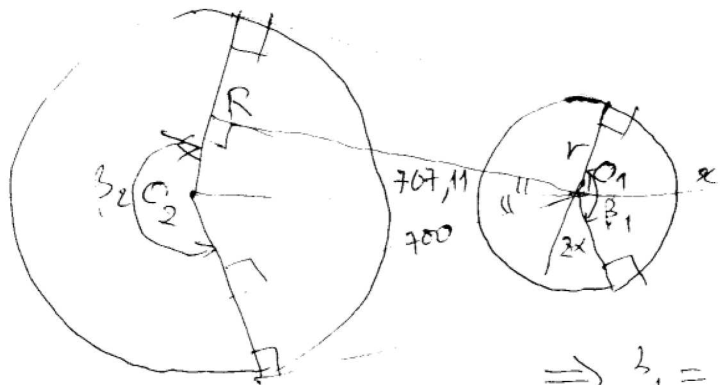
$$\Rightarrow \delta = \frac{\omega_{max}-\omega_{min}}{\omega_{tb}} = 0{,}014\ \ (1{,}4\%)$$ (2 đ)

e/ $[\delta] = \frac{\delta}{2} = 0{,}007$

$J_đ \frac{\omega_2^2}{\omega_1^2} = \Delta J_đ = \frac{\max\left|\int_{\varphi_1}^{\varphi_2} (M_c + M_đ) d\varphi\right|}{\omega_{tb}^2 \cdot [\delta]} - J_{tđ} = 0{,}08 \ Kgm^2$

$\frac{\omega_2}{\omega_1} = \frac{1}{3} \Rightarrow J_đ = 0{,}72 \ Kgm^2$ (2đ)

(2)



$O_1O_2 = \sqrt{\left(\frac{700}{2} - \frac{500}{2}\right)^2 + 700^2} = 707{,}11 \ mm.$

$\alpha = \operatorname{arctg}\left(\frac{\frac{700}{2} - \frac{500}{2}}{707{,}11}\right) \simeq 8{,}13^\circ$

$\Rightarrow \beta_1 = 180^\circ - 2\alpha = 163{,}77^\circ \simeq 2{,}855 \ rad$

$\beta_2 = 180^\circ + 2\alpha = \ldots$ (1đ)

$M_{ms_1} = 2 S_0 R \frac{e^{f\beta_1} - 1}{e^{f\beta_1} + 1} \simeq 0{,}178 \ Nm.$

$M_{ms_2} = 2 S_0 R \frac{e^{f\beta_2} - 1}{e^{f\beta_2} + 1} \simeq \ldots > 0{,}178 \ Nm.$ (1đ)

$\Rightarrow$ Khả năng tải $M = \min\{M_{ms_1}, M_{ms_2}\} = 0{,}178 \ Nm$

(1đ)