Intro to Robotics
Assignment - 2b

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ME17B179

1. $\theta_1 = a_{10} + a_{11}t + a_{12}t^2 + a_{13}t^3$

$\theta_2 = a_{20} + a_{21}t + a_{22}t^2 + a_{23}t^3$

$\theta_0 = 5^\circ$
$\theta_v = 15^\circ$
$\theta_g = -10^\circ$

Conditions

$\theta_1(0) = \theta_0 \rightarrow (1)$

$\theta_1(2) = \theta_v \rightarrow (2)$

$\dot{\theta}_1(0) = 0 \rightarrow (3)$

$\theta_2(2) = \theta_g \rightarrow (4)$

$\dot{\theta}_2(0) = \dot{\theta}_1(2) \rightarrow (5)$

$\ddot{\theta}_2(0) = \ddot{\theta}_1(2) \rightarrow (6)$

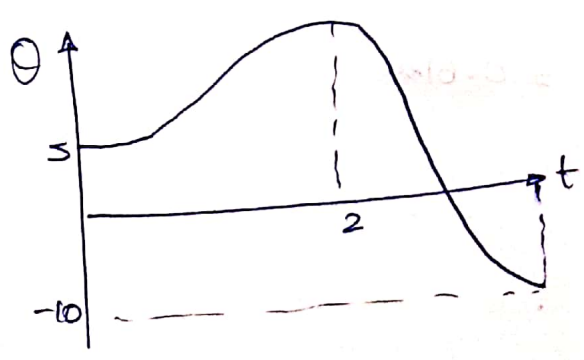
$\theta_2(0) = \theta_v \rightarrow (7)$

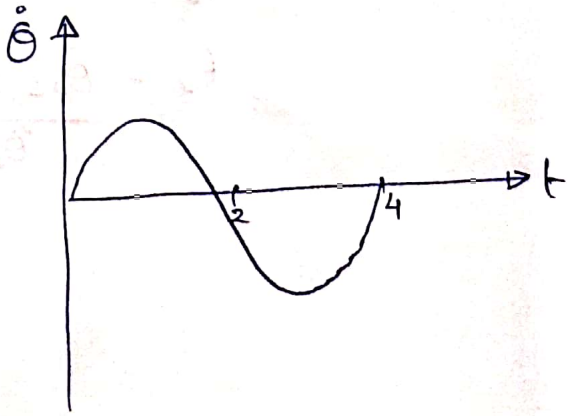
$\dot{\theta}_2(2) = 0 \rightarrow (8)$

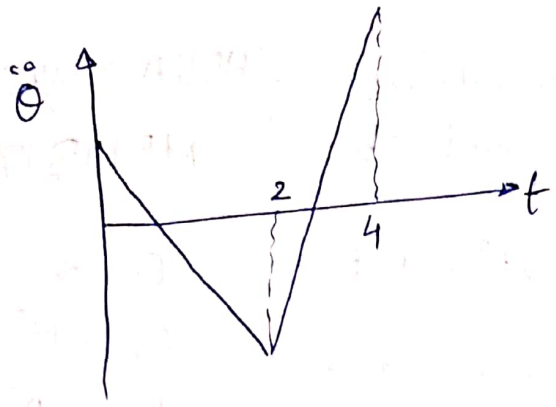
By solving we get Coffecients

$a_{10} = 5 \quad a_{11} = 0 \quad a_{12} = 10.312 \quad a_{13} = -3.9$

$a_{20} = 15 \quad a_{21} = -5.625 \quad a_{22} = -13.125 \quad a_{23} = 4.84$







2. Start segment

$$\ddot{\theta}_1 = +60$$

$$t_1 = 2 - \sqrt{2^2 - \frac{2(10)}{60}} = 0.085 \text{ sec}$$

$$\dot{\theta}_{12} = \frac{\theta_2 - \theta_1}{t_{d12} - t_1/2} = 5.108 \text{ deg/sec}$$

final segment

$$\ddot{\theta}_3 = +60$$

$$t_3 = t_{d23} - \sqrt{t_{d23}^2 - \frac{2(\theta_2 - \theta_3)}{\ddot{\theta}_3}} = 0.528 \text{ sec}$$

$$\dot{\theta}_{23} = \frac{\theta_3 - \theta_2}{t_{d23} - \frac{t_3}{2}} = -31.68 \text{ deg/sec}$$

Interior

$$\ddot{\theta}_2 = -60$$

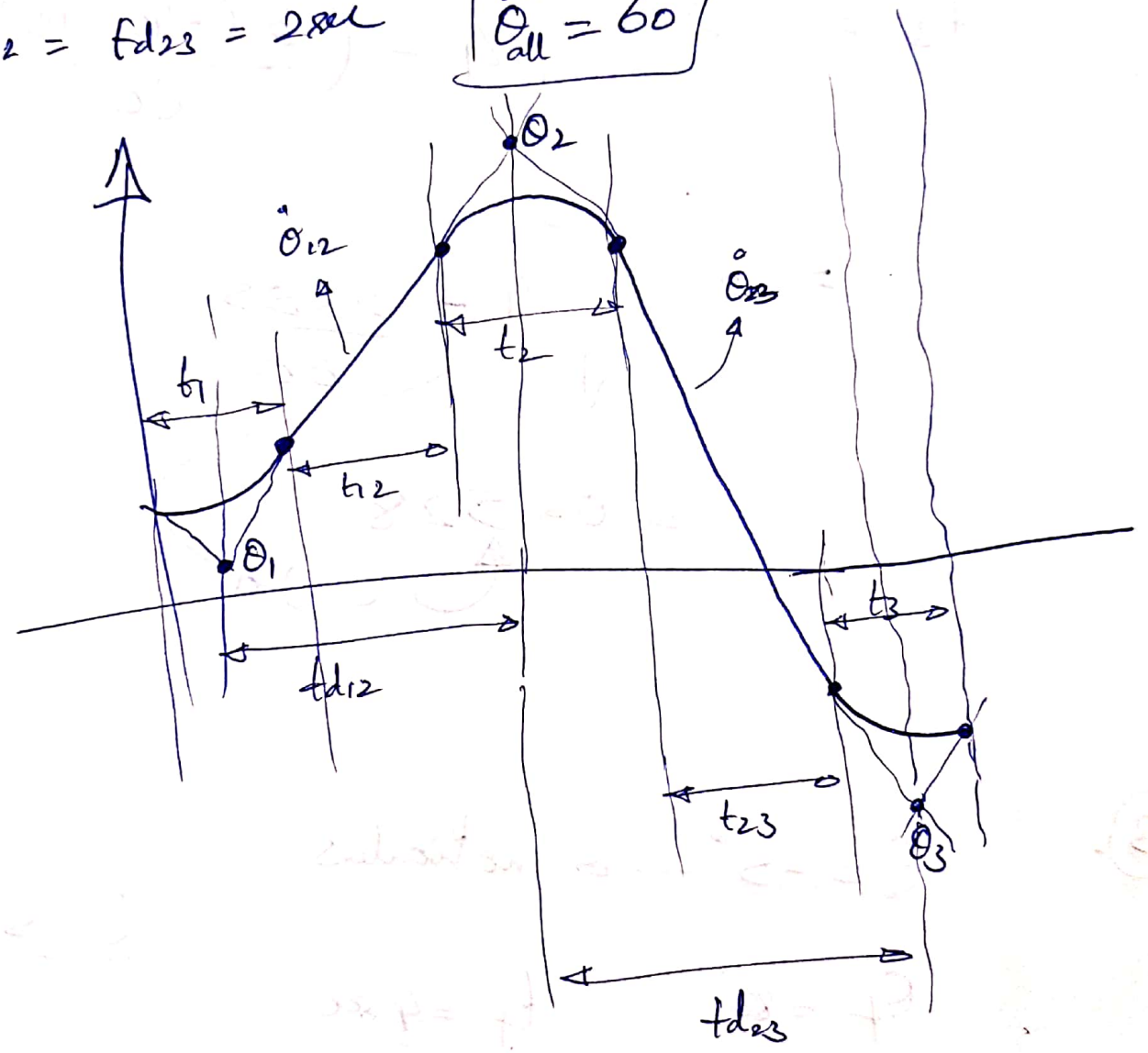
$$t_2 = \frac{\dot{\theta}_{23} - \dot{\theta}_{12}}{\ddot{\theta}_2} = 0.61 \text{ sec}$$

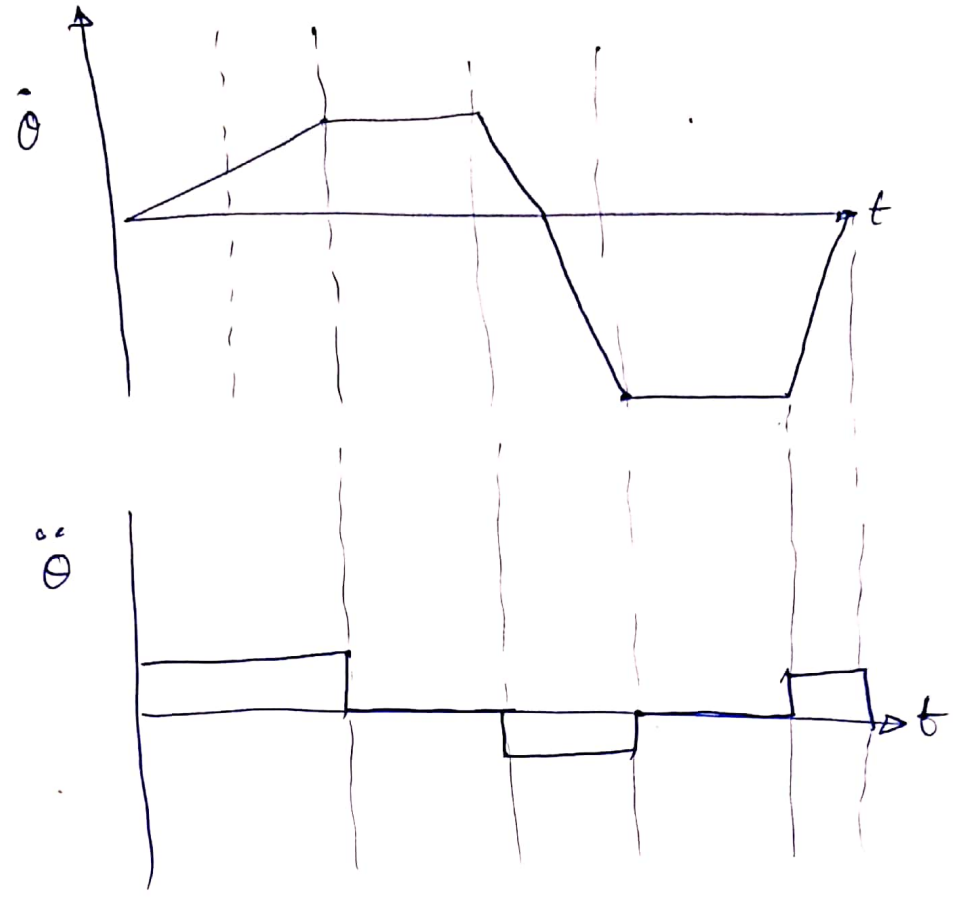
$\dot{\theta}_{12}, \dot{\theta}_{23}, t_1, t_2, t_3 = ?$

2 segment linear Spline with parabolic blends

$\theta_1 = 5^\circ \quad \theta_2 = 15^\circ \quad \theta_3 = -40^\circ$

$t_{d12} = t_{d23} = 2\text{sec}$ $\quad \dot{\theta}_{all}^{60} = 60$





3.) $q_1 = 5^\circ \qquad q_2 = 80^\circ$

$$t_b = \frac{4}{2} - \sqrt{4 - \left(\frac{80+5}{\ddot{\theta}}\right)} \qquad t_b = 2 - \sqrt{4 - 85/\ddot{\theta}}$$

Let $\ddot{\theta} = 60^\circ/sec^2$

$$t_b = 0.39 \text{ sec}$$

$$\dot{\theta} = \ddot{\theta}_b \times t_b = 60 \times 0.39 = 23.4^\circ/sec$$