

Fundamental Mathematics for Robotics
Homework Set #11-2, Dr.T

[1] Find the indefinite integral (anti-derivative) $F(x)$ of the following functions.

(a) $f(x) = \frac{2}{(x+2)(x+3)}$

(b) $f(x) = \frac{3x+7}{(x+2)(x+3)}$

(c) $f(x) = \frac{x^2+8x+13}{(x+2)(x+3)}$

[2] Let us compute the angle of a joint of a robot from the following torque profile. Let us assume that the moment of inertia $I = 1/2$.

$$\tau(t) = \begin{cases} \pi/6, & 0 \leq t < 2 \\ 0, & 2 \leq t < 5 \\ -\pi/9, & 5 \leq t \leq 8 \end{cases}$$

Note that the torque = 0 outside of the given interval.

(a) Plot the torque profile.

(b) Find the angular speed $\omega(t)$ assuming that the joint is at rest at time $t = 0$.

(c) Plot the angular speed.

(d) Find the joint angle $\theta(t)$ assuming that the initial angle is $-\pi/2$ at time $t = 0$.

(e) Plot the angle $\theta(t)$.

[3] Compute the following integrals:

(a) Definite integral: $F(t) = \int_0^t 3(t-u)du$

(b) Definite integral: $F(t) = \int_0^t 4e^{t-u}du$

(c) Indefinite integral: $I = \int e^{at} \cos bt dt$

(d) (Extra) Indefinite integral: $I = \int \frac{1}{x^2+1} dx$

(e) (Extra) Indefinite integral: $I = \int \frac{1}{\cos^2 \theta} d\theta$