**Estimating Blood Flow Using Fick’s Principle**

**Background**

In clinical settings, Fick’s Method is used to calculate blood flow (F) based on the relationship between the amount of indicator injected and the integral of its concentration in the blood over time:

Where:

* F is the average flow (mL/s),
* m is the total amount of indicator injected (mg)
* C(t) is the blood concentration of the indicator at time t (mg/mL).

In practice, this method is used to estimate cardiac output, particularly in dye-dilution and thermal-dilution techniques. This assignment will simulate an injection of a dye indicator into the bloodstream and tracks its concentration over time.

Please refer to the *Measurement of Flow and Volume of Blood* Lecture for detailed information on Fick’s Method and cardiac output, feel free to use this material in your report.

**Objectives**

1. Simulate time-varying indicator injection and blood concentration data.
2. Use a loop and numerical integration to calculate the total quantity of indicator m and the flow F(t) over time.
3. Visualize how the estimated flow changes as more data is collected.

**Deliverables**

* Submit your .m file with your code.
* Include a screenshot of your output plots:
  1. The blood concentration, C(t)
  2. The estimated flow, F(t)
* Write a short paragraph answering the following:
  1. How does the estimated flow F(t) behave over time?
  2. What could affect the accuracy of this flow measurement in real life?

**Instructions**

To begin, start with defining your time vector, simulated concentration in blood, and injection rate using the following code:

% Time vector

t = linspace(0, 60, 100); % 1 minute, 100 samples

% Indicator decaying injection rate Fi(t) in mg/s

Fi = 5 \* exp(-0.1 \* t);

% Simulated concentration in blood C(t) in mg/mL

C = 0.2 + 0.1 \* sin(0.1 \* t);

Using these values, implement a for loop to iterate through the equations provided above and plot the cumulative indicator [m(t)], concentration [c(t)], and flow over time [F(t)].