- Chú thích câu lệnh matlab

- syms (symbolic): khai báo biến hoặc hàm symbolic.
- diff (differences/derivative): tính đạo hàm của biểu thức hoặc hàm số symbolic.
- dsolve (differential solve): giải phương trình vi phân.
- solve: giải phương trình tìm ẩn
- vpa (variable-precision arithmetic): chuyển đổi kết quả symbolic thành số thập phân và làm tròn tới n chữ số có nghĩa.
- subs (substitute): thay thế một biến trong hàm symbolic bằng một giá trị.

Bài 7.1

Câu lệnh matlab:

```
syms t S(t)
eq = diff(S) == 0.01*S - 2*10^6
cond = S(0) == 45*10^6
S(t) = dsolve(eq, cond)
t = solve(S(t), t);
t = vpa(t, 5)
```

Kết quả in ra:

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{S(t)}{100} - 2000000$$

cond = $S(0) = 45000000$

S(t) = $200000000 - 155000000\, e^{t/100}$

t = 25.489

Bài 7.2

Câu lệnh matlab:

```
syms t S(t)
eq = diff(S) == 0.015*S - 1*10^6
cond = S(0) == 46*10^6
S(t) = dsolve(eq, cond)
t = solve(S(t), t);
t = vpa(t, 6)
```

Kết quả in ra:

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{200} - 1000000$$

cond = $S(0) = 46000000$

S(t) =

$$\frac{200000000}{3} - \frac{62000000\, e^{\frac{3t}{200}}}{3}$$

t = 78.0789

Bài 7.3

Câu lệnh matlab:

```
syms t S(t)
eq = diff(S) == 0.12*S - 240*10^6
cond = S(15) == 0
S(t) = dsolve(eq, cond)
P0 = 2.2*10^9 - S(0);
P0 = vpa(P0, 11)
```

Kết quả in ra:

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{25} - 240000000$$

cond = $S(15) = 0$

S(t) =

$$2000000000 - 2000000000\,e^{\frac{3t}{25}}\,e^{-\frac{9}{5}}$$

P0 = 530597776.44

Bài 7.4

```
syms t S(t) P0
eq = diff(S) == 0.008*S - 10^6
cond = S(0) == 27*10^6 - P0
S(t) = dsolve(eq, cond)
P0 = solve(S(18), P0);
P0 = vpa(P0, 10)
```

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{S(t)}{125} - 1000000$$

cond = $S(0) = 27000000 - P_0$

S(t) = $125000000 - e^{t/125}\,(P_0 + 98000000)$

P0 = 10235968.51

Bài 7.5

```
syms t S(t) M
eq = diff(S) == 0.01*S - M
cond = S(0) == 42*10^6
S(t) = dsolve(eq, cond)
M = solve(S(18), M);
M = vpa(M, 9)
```

```
eq(t) =
```

$$\frac{\partial}{\partial t} S(t) = \frac{S(t)}{100} - M$$

```
cond = S(0) = 42000000
```

```
S(t) = 100 M - e^(t/100) (100 M - 42000000)
```

```
M = 2549629.93
```

Bài 7.6

```
syms t S(t) t0
eq = diff(S) == 0.004*S - 2*10^6
cond = S(0) == 10^8
S(t) = dsolve(eq, cond)
t0 = solve(S(t0), t0);
t0 = vpa(t0, 5)
```

```
eq(t) =
```

$$\frac{\partial}{\partial t} S(t) = \frac{S(t)}{250} - 2000000$$

```
cond = S(0) = 100000000
```

```
S(t) = 500000000 - 400000000 e^(t/250)
```

```
t0 = 55.786
```

Bài 7.7

```
syms t S(t) t0
eq = diff(S) == 0.06*S + 12*10^7
cond = S(0) == 10^8
S(t) = dsolve(eq, cond)
t0 = solve(S(t0) == 1.5*10^9, t0);
t0 = vpa(t0, 6)
```

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{50} + 120000000$$

cond = $S(0) = 100000000$

S(t) =

$$2100000000\, e^{\frac{3t}{50}} - 2000000000$$

t0 = 8.51376

Bài 7.8

```
syms t S(t) rt
eq = diff(S) == rt*S - 12*10^6
cond = S(0) == 680*10^6
S(t) = dsolve(eq, cond)
rt = solve(S(60) == 0, rt);
rt = vpa(rt, 3)
rn = 12*log(1 + rt);   %(log trong matlab la log tu nhien)
rn = vpa(rn, 2)
```

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \mathrm{rt}\, S(t) - 12000000$$

cond = $S(0) = 680000000$

S(t) =

$$\frac{e^{\mathrm{rt}\,t}\,(680000000\,\mathrm{rt} - 12000000) + 12000000}{\mathrm{rt}}$$

rt = 0.00192

rn = 0.023

Bài 7.9

```
syms t S(t)
eq = diff(S) == 0.03*S + 15*10^6
cond = S(0) == 0
S(t) = dsolve(eq, cond)
S = subs(S,12);
S = vpa(S, 11)
```

```
eq(t) =
```

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{100} + 15000000$$

```
cond =
```

$$S(0) = 0$$

```
S(t) =
```

$$500000000\,e^{\frac{3t}{100}} - 500000000$$

```
S(t) = 216664707.28
```

Bài 7.10

```
syms t S(t) t0
eq = diff(S) == 0.03*S + 15*10^6
cond = S(0) == 0
S(t) = dsolve(eq, cond)
t0 = solve(S(t0) == 150* 10^6, t0);
t0 = vpa(t0, 3)
```

```
eq(t) =
```

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{100} + 15000000$$

```
cond =
```

$$S(0) = 0$$

```
S(t) =
```

$$500000000\,e^{\frac{3t}{100}} - 500000000$$

```
t0 = 8.75
```

Bài 7.11

```
syms t S(t)
eq = diff(S) == 0.036*S - 22*10^6
cond = S(36) == 0
S(t) = dsolve(eq, cond)
S = subs(S,0);
S = vpa(S, 11)
```

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{9\,S(t)}{250} - 22000000$$

cond = $S(36) = 0$

S(t) =

$$\frac{5500000000}{9} - \frac{5500000000\,e^{\frac{9t}{250}}\,e^{-\frac{162}{125}}}{9}$$

S(t) = 443896381.27

Bài 7.12

```
syms t S(t) t0
eq = diff(S) == 0.015*S - 230*10^6
cond = S(0) == 4.5*10^9
S(t) = dsolve(eq, cond)
t0 = solve(S(t0), t0);
t0 = vpa(t0, 4)
```

eq(t) =

$$\frac{\partial}{\partial t} S(t) = \frac{3\,S(t)}{200} - 230000000$$

cond = $S(0) = 4500000000$

S(t) =

$$\frac{46000000000}{3} - \frac{32500000000\,e^{\frac{3t}{200}}}{3}$$

t0 = 23.16