

## Nonlinear Dynamics in Electric Circuits (10 points)

### Part A. Stationary states and instabilities (3 points)

**A.1** (0.4 pt)

$$R_{\text{on}} =$$

$$R_{\text{off}} =$$

$$I_0 =$$

$$R_{\text{int}} =$$

**A.2** (1 pt)

Possible numbers of stationary states for  $R = 3.00 \Omega$  :

Possible numbers of stationary states for  $R = 1.00 \Omega$  :

**A.3** (0.6 pt)

$$I_{\text{stationary}} =$$

$$V_{\text{stationary}} =$$

**A.4** (1 pt)

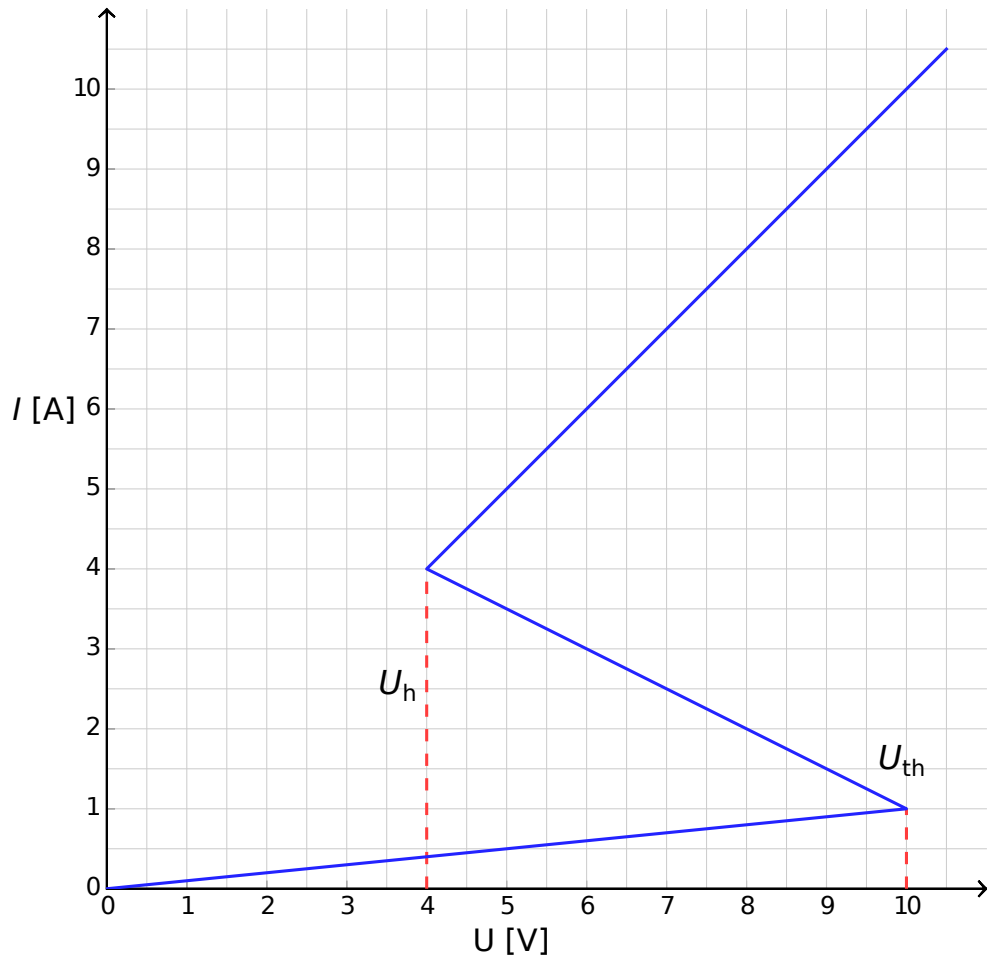
Behaviour for  $I(t = 0) > I_{\text{stationary}}$  :

Behaviour for  $I(t = 0) < I_{\text{stationary}}$  :

Is the stationary state:  stable?  unstable?

**Part B. Bistable non-linear elements in physics: radio transmitter (5 points)**

**B.1** (1.8 pt)



Justification:

**B.2** (1.9 pt)

Expression:  $t_1 =$

Numerical value of  $t_1 =$

Expression:  $t_2 =$

Numerical value of  $t_2 =$

Numerical value of  $T =$

**B.3** (0.7 pt)

$P \approx$

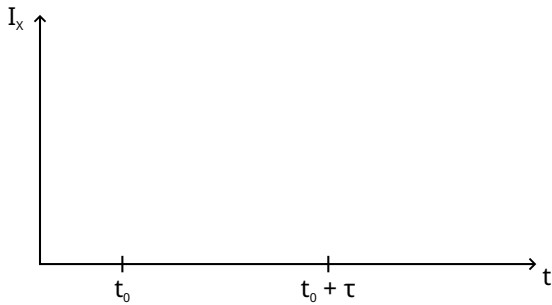
**B.4** (0.6 pt)

$s =$

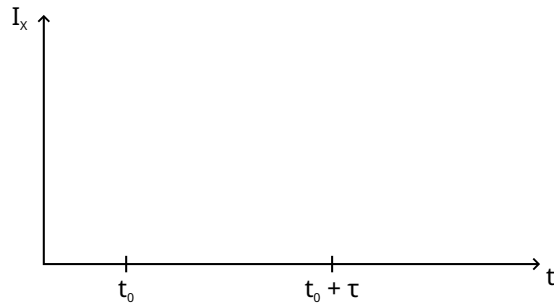
**Part C. Bistable non-linear elements in biology: neuristor (2 points)**

**C.1** (1.2 pt)

Sketch for  $\tau < \tau_{\text{crit}}$  :



Sketch for  $\tau > \tau_{\text{crit}}$  :



**C.2** (0.6 pt)

Expression:  $\tau_{\text{crit}} =$

Numerical value of  $\tau_{\text{crit}} =$

**C.3** (0.2 pt)

Is the circuit a neuristor?  Yes  No