



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

**Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai**

DEPARTMENT OF BIOMEDICAL ENGINEERING

COURSE NAME: 19BMT301 Bio Control Systems

III YEAR / V SEMESTER

Unit 2– Time Response

Topic 1: First Order System





What We'll Discuss

TOPIC OUTLINE



Introduction

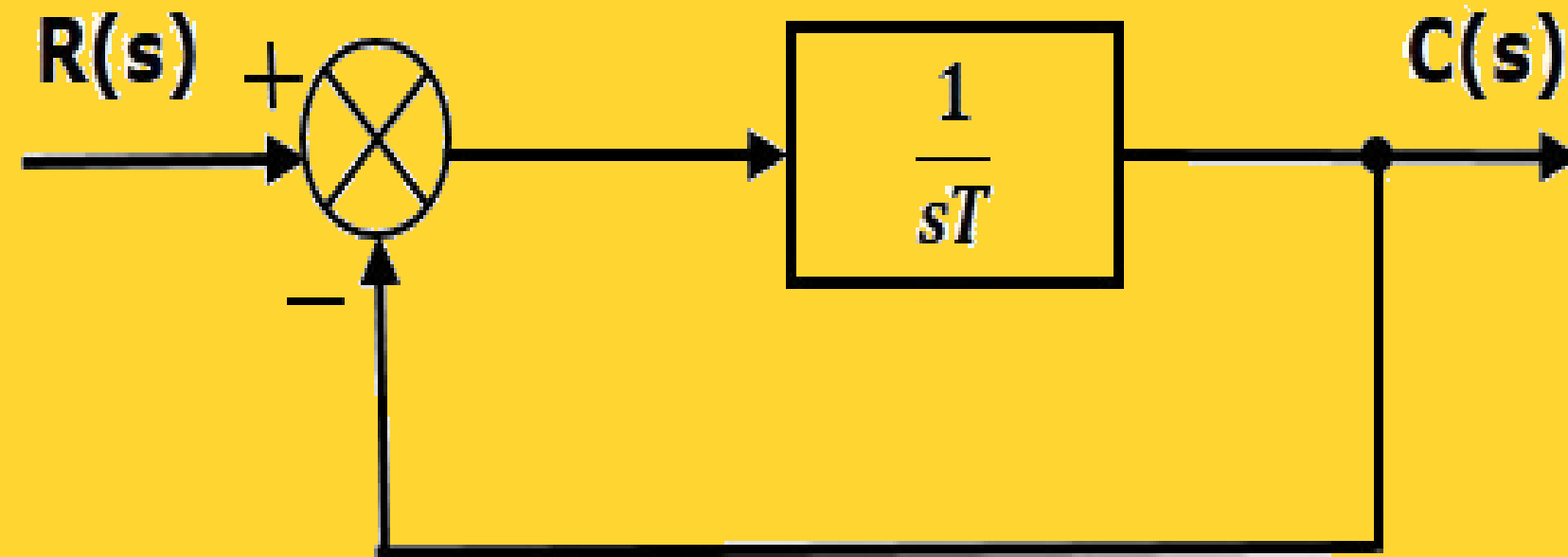
Response of First Order System



Introduction



- Consider the following block diagram of the closed loop control system.
- Here, an open loop transfer function, $1/sT$ is connected with a unity negative feedback. The system is called as first order system





First Oder Response

- The closed loop transfer function of the system is given by

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 + G(s)}$$

- Substituting the transfer function for first order system in above equation

$$\frac{C(s)}{R(s)} = \frac{\frac{1}{sT}}{1 + \frac{1}{sT}} = \frac{1}{sT + 1}$$

$$R(s) = \frac{1}{s}$$



First Order Response



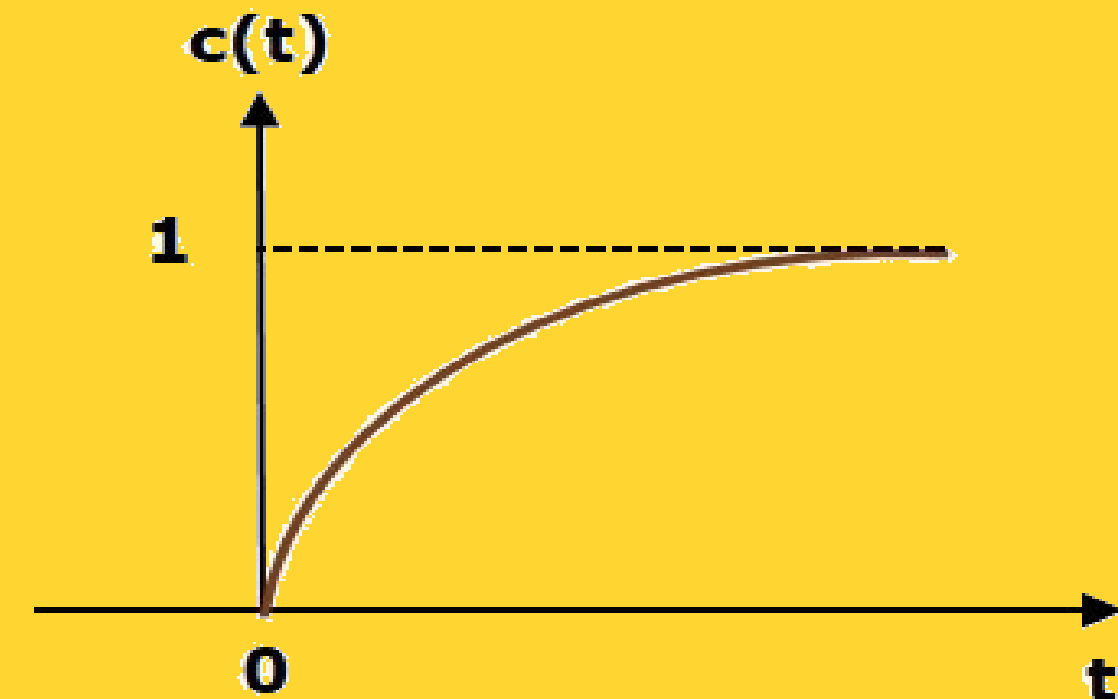
$$C(s) = \left(\frac{1}{sT + 1} \right) \left(\frac{1}{s} \right) = \frac{1}{s(sT + 1)}$$

$$C(s) = \frac{1}{s(sT + 1)} = \frac{A}{s} + \frac{B}{sT + 1}$$

$$C(s) = \frac{1}{s} - \frac{T}{sT + 1} = \frac{1}{s} - \frac{T}{T(s + \frac{1}{T})}$$

Applying Laplace inverse transform

$$c(t) = \left(1 - e^{-\left(\frac{t}{T}\right)} \right)$$

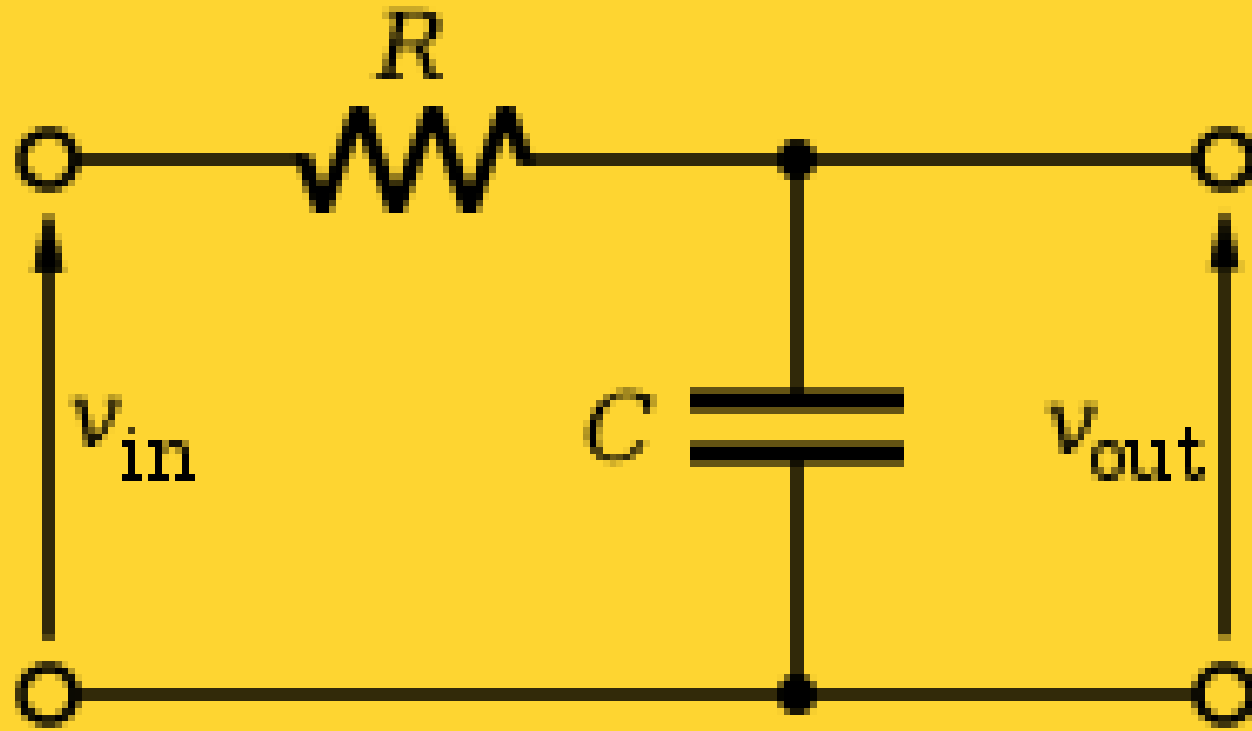




Practical Example



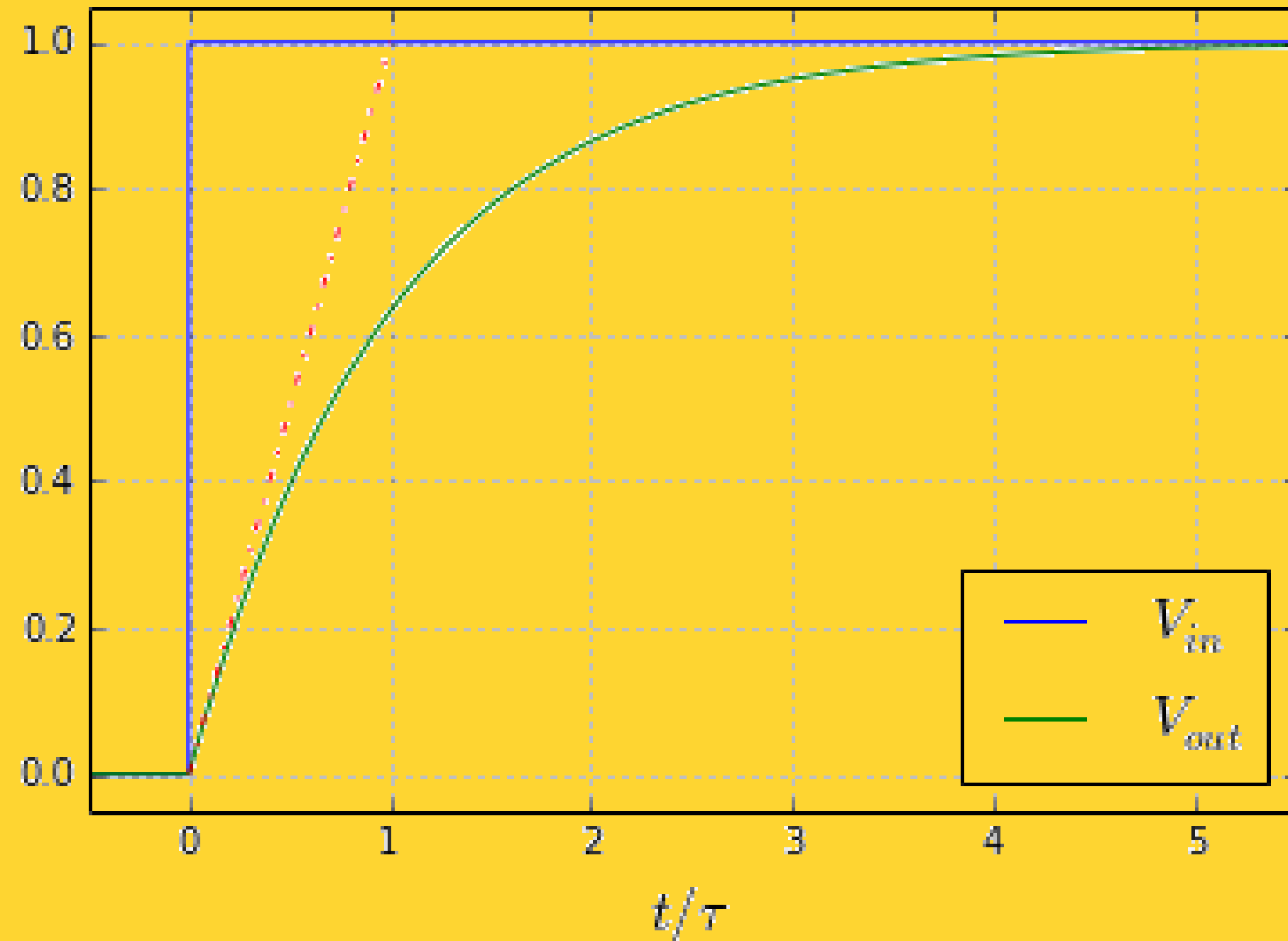
A first-order RC filter:



$$\frac{dV_{out}}{dt} = \frac{1}{RC} (V_{in} - V_{out})$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{1}{1 + sRC}$$

Unit step response of an RC filter with time constant $\tau = RC$





RECALL TIME

ASSESSMENT
TIME



THANK YOU