Portland State University

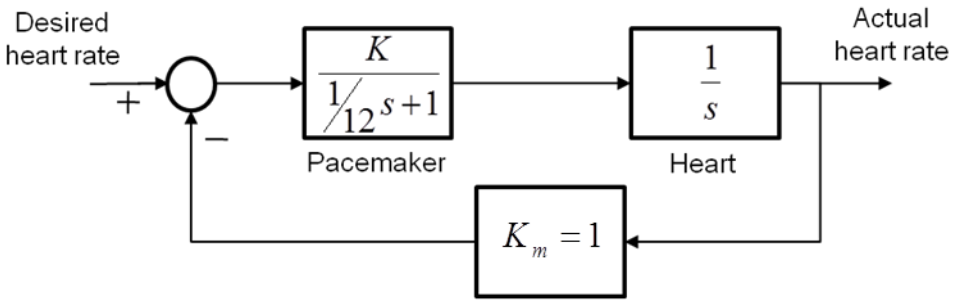
Electrical & Computer Engineering

ECE 311 Feedback & Control

-Homework #3-

Text Problems: **B-5-12, B-5-13, B-5-14, B-5-15**

Problem 1:
A proposed closed-loop system that includes a pacemaker and the measurement of heart rate is shown below.



Design the amplifier gain to satisfy the requirement that overshoot to a step in desired heart rate should be less than 10% Find a suitable range of K.

Problem 2:
A second order-control system has the following system specifications for a step input:

(1) Percent overshoot: $PO \le 5\%$

(2) Settling time (2%): $T_s < 4\text{sec}$

(3) Peak time: $T_p < 1\text{sec}$

Show the permissible area for the poles of the closed-loop system in order to achieve the desired response.

Problem 3:
Consider standard second order system:

$$T(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

(a) Find the region of allowable *s*-plane pole locations such that the system 2% settling time is less than 2 seconds and overshoot is less than 10 percent

(b) Solve for the allowable ranges of ω_n and ξ for (a)

Fundamentals of Engineering Exam Problem 1:

The inverse Laplace transform of G(s) is most nearly:

$$G(s) = \frac{5}{(s+3)^2}$$

(A) $15te^{-3t}$
(B) $15e^{-3t}$
(C) $5te^{-3t}$
(D) $5e^{-3t}$

Fundamentals of Engineering Exam Problem 2:

The inverse Laplace transform of G(s) is most nearly:

$$G(s) = \frac{5}{s^2 + 8s + 41}$$

(A) $e^{-4t} + e^{-5t}$
(B) $e^{-4t}\cos 5t$
(C) $e^{-4t}\sin 5t$
(D) te^{-4t}