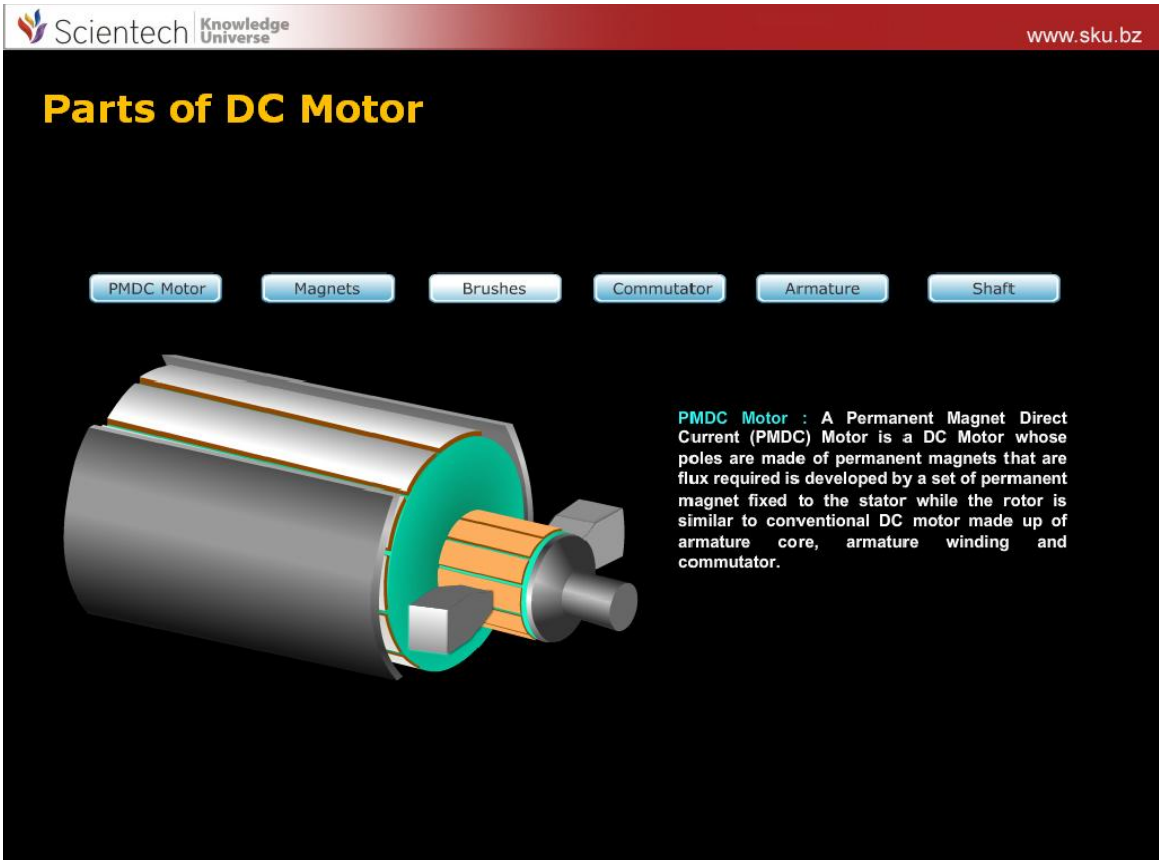
Topics Covered in SKU- Control Engineering



Unit I - Introduction to the Control Problem

Basic Control System Terminology viz. open loop & close loop system, Servomechanism, Feed forward & Feedback control, Digital Control, Multivariable Control System, Non-Linear Control System.

Modelling Techniques for Physical System:
Differential Modelling of Physical Systems, Linear Approximations of Physical Systems, and The Laplace Transform, The transfer function of linear system, Block Diagram algebra, and Signal Flow graphs.

Control System Components & Their Mathematical Modeling:
S.C. Servomotors, A.C. Servomotors, Pneumatic devices for control, Hydraulic Devices for control, Synchros, A/D Converters.

Unit II - Feedback Control System Characteristics

Sensitivity of control systems to parameter variation, Control over the dynamics of the system, Disturbance signals in a feedback control system, Steady-state Error.

Time Response Studies:
Difference of time response, Test input signals, model of prototype D.C. position control system, Time response of prototype second order system, Performance specifications of the

prototype 2nd order system, Effects of additions of poles and zeros to open loop & close loop transfer functions, time response of higher order s, stems & concept of dominant pole, Steady-state error constants for type 0, 1 & @ systems, Need for compensation for the prototype 2nd order system.

Unit III - Time Domain Stability Analysis

Concept of stability of linear systems, bounded input bounded output / zero-input stability, The routh stability criteria, Stability range for a parameter, Co-relation between the closed loop poles & stability, The Root-locus concept, Guidelines for sketching Root-locus, Elementary idea of reshaping the Root-locus, Root-locus of systems with Dead time , Root sensitivity.

Frequency Domain Analysis of Control System
Performance specification in frequency domain, Co-relation between frequency domain & time domain, Polar plots, Bode plots, Nicholas Charts, Determination of system transfer function from experimental data.

Stability Analysis in Frequency Domain
Development of Nyquist Criteria stability margins, Relative stability using Nyquist and border plots, Systems with dead time.

Design of feedback control systems
Approaches to system design, Cascade compensation networks, Design of Compensators in Time & Frequency domain, Examples of proportional, PD & PID mode of control.

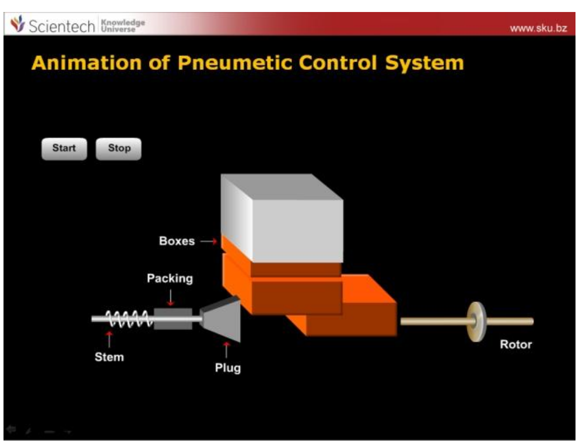
Unit IV - State Variable Techniques

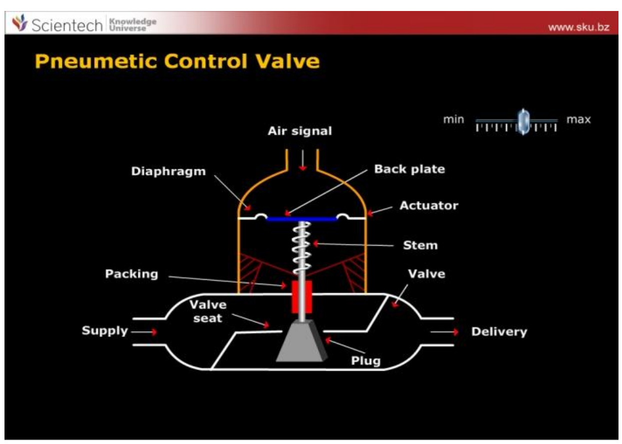
State variable representation for an LTI system, Different Counouical forms, Co- relation between state models & Transfer function, Solution Of State Equations, Concepts of controllability & observability.

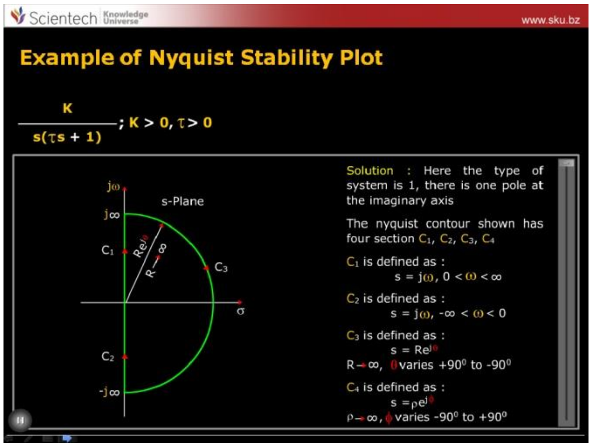
Unit V - Introduction to Software Packages Used in Control System

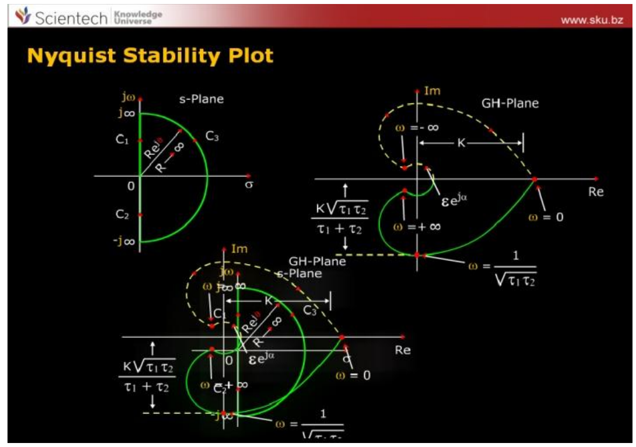
MATLAB, SIMULINK

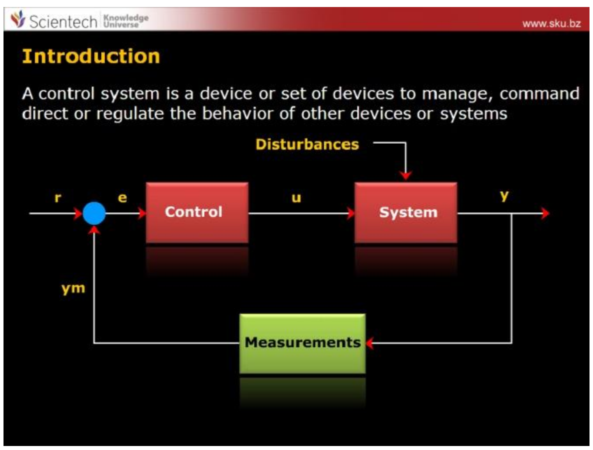
Print Shots of SKU- Basic Civil Engineering & Engineering Mechanics:

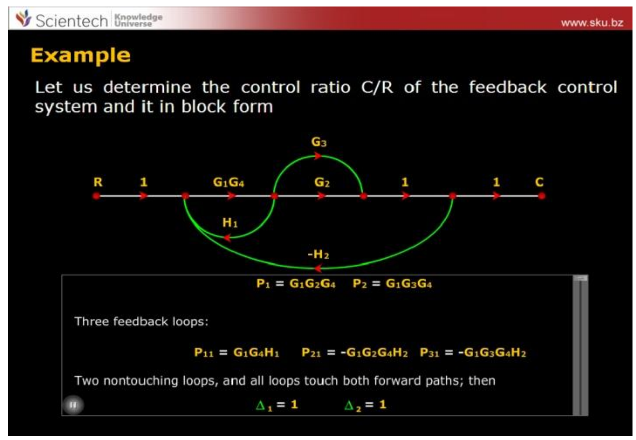





Example of Nyquist Stability Plot
K / s(τs + 1); K > 0, τ > 0
jω
j∞
s-Plane
C₁
C₃
C₂
-j∞
σ
Solution : Here the type of system is 1, there is one pole at the imaginary axis
The nyquist contour shown has four section C₁, C₂, C₃, C₄
C₁ is defined as :
s = jω, 0 < ω < ∞
C₂ is defined as :
s = jω, -∞ < ω < 0
C₃ is defined as :
R→∞, θ varies +90⁰ to -90⁰
C₄ is defined as :
varies -90⁰ to +90⁰


Nyquist Stability Plot
s-Plane
GH-Plane
Im
Re
σ
ω = -∞
ω = +∞
ω = 0
K
K√τ₁τ₂ / τ₁ + τ₂


Introduction
A control system is a device or set of devices to manage, command direct or regulate the behavior of other devices or systems
Disturbances
r
e
Control
u
System
y
ym
Measurements


Example
Let us determine the control ratio C/R of the feedback control system and it in block form
G₃
R
1
G₁G₄
G₂
1
1
C
H₁
-H₂
P₁ = G₁G₂G₄ P₂ = G₁G₃G₄
Three feedback loops:
P₁₁ = G₁G₄H₁ P₂₁ = -G₁G₂G₄H₂ P₃₁ = -G₁G₃G₄H₂
Two nontouching loops, and all loops touch both forward paths; then
Δ₁ = 1 Δ₂ = 1