Process Control
Assignment

الاسم : كريم أسامة السيد عبد الرحمن
السشكن : 2

Variables of Process Examples

1. Lime Mud Filter

- **PV**: Moisture content in the filtered mud
- **MV**: Drum speed / Vacuum pressure / Wash water flow rate
- **Load disturbance**: Incoming mud consistency or feed rate

2. Paper Machine Basis Weight

- **PV**: Basis weight (mass of paper per unit area, e.g., g/m^2)
- **MV**: Flow rate of pulp to the headbox / Jet-to-wire speed ratio
- **Load disturbance**: Pulp consistency or stock composition

3. Boiler Combustion Pressure

- **PV**: Furnace/combustion chamber pressure
- **MV**: Air/fuel ratio (air or fuel flow)
- **Load disturbance**: Changes in steam demand or fuel quality

4. Steam Drum Water Level

- **PV**: Water level in the steam drum
- **MV**: Feedwater flow rate
- **Load disturbance**: Steam flow rate (which affects how fast water is leaving)

5. Distillate Composition in a Distillation Column

- **PV**: Mole fraction or percentage of a key component in distillate
- **MV**: Reflux ratio or distillate flow rate
- **Load disturbance**: Feed composition or feed flow rate

6. Ammonia Plant Hydrogen-to-Nitrogen Ratio

- **PV**: H_2:N_2 molar ratio
- **MV**: Control valve position on hydrogen or nitrogen feed lines
- **Load disturbance**: Upstream changes in hydrogen or nitrogen supply purity or flow

Relative Gain Array (RGA)

Why do rows/columns sum to 1?

The RGA matrix Λ is defined as:

$\Lambda = G \circ (G^{-1})^T$

Where:

- G is the steady-state gain matrix,
- $\circ$ is the element-wise (Hadamard) product,
- $(G^{-1})^T$ is the transpose of the inverse of the gain matrix.

Because of this specific mathematical structure, **each element λ_{ij}** measures the effect of MV j on CV i, **relative to the system as a whole**.

Row and column sums

- **Each row sums to 1**: You're looking at how each controlled variable (CV) is influenced across all MVs. Total influence must account for 100% — hence, the sum is 1.
- **Each column sums to 1**: Similarly, each MV distributes its influence among all CVs. Again, total relative influence = 100%.