



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

Failure Analysis and Prevention

Industrial Engineering Tools for FA: Reliability I

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Reliability

- ❑ Ability of a product to perform as expected over time.
- ❑ Defined as the probability that a product, piece of equipment, or system will perform its intended function for a stated period of time under specified operating conditions.



Reliability

There are four factors associated with Reliability: probability, function, life and environment

1. Numerical Value.

□ The numerical value is the probability that the product will function satisfactorily during a particular time.



Reliability

There are four factors associated with Reliability:

2. Intended Function.

❑ Product are designed for particular applications and are expected to be able to perform those applications.



Reliability

There are four factors associated with Reliability:

3. Life.

❑ How long the product is expected to last.

Product life is specified as a function of usage, time, or both.



Reliability

There are four factors associated with Reliability:

4. Environmental Conditions

- ☐ Indoors.
- ☐ Outdoors.
- ☐ Storage.
- ☐ Transportation.



System Reliability

- ❑ As products become more complex (have more components), the chance that they will not function increases.
- ❑ The method of arranging the components affects the reliability of the entire system.
- ❑ Components can be arranged in series, parallel, or a combination.



Series System

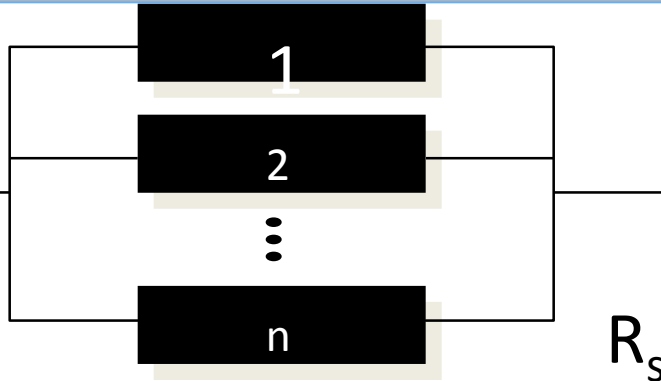
- ❑ For a series systems, the reliability is the product of the individual components.



$$R_s = R_1 R_2 \dots R_n$$

- ❑ As components are added to the series, the system reliability decreases.

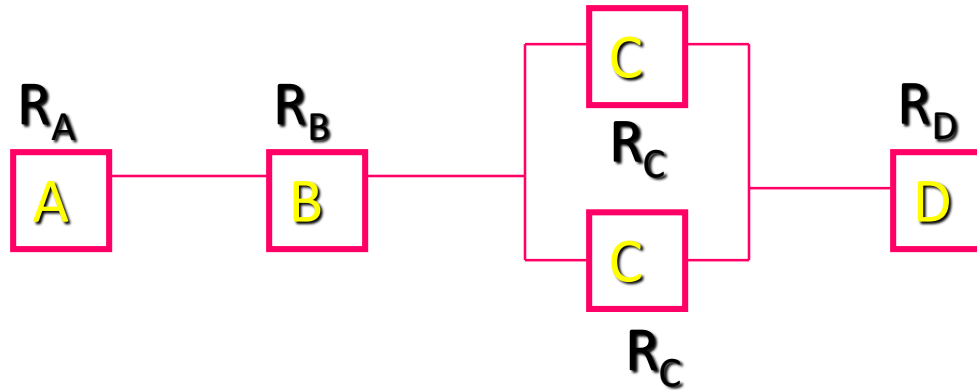
Parallel System



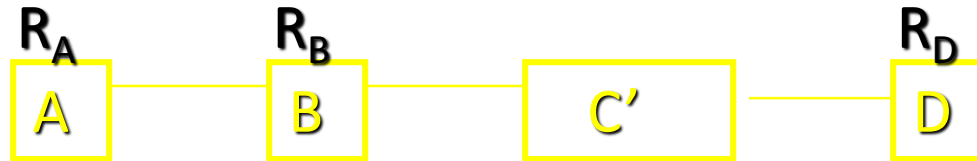
$$R_s = 1 - (1 - R_1) (1 - R_2) \dots (1 - R_n)$$

- ❑ When a component does not function, the product continues to function, using another component, until all parallel components do not function.

Series-Parallel System



□ Convert to equivalent series system



$$R_{C'} = 1 - (1 - R_C)(1 - R_C)$$

Factors matter for reliability

- Design
- Production
- Transportation



Design

- ☐ The most important aspect of reliability is the design.
- ☐ **Simple design**
- ☐ Fewer **number of components**
- ☐ Backup or redundant component (**parallel component**).



Design

- ☐ Overdesign.
- ☐ Large factors of safety
- ☐ Maintenance



Production

- ☐ Emphasis on **least reliable**
- ☐ **Process control**
- ☐ **Close tolerance**
- ☐ Production personnel.



Transportation

- ❑ The third most important aspect of reliability is the transportation.
 - ❑ Packaging
 - ❑ Shipment

