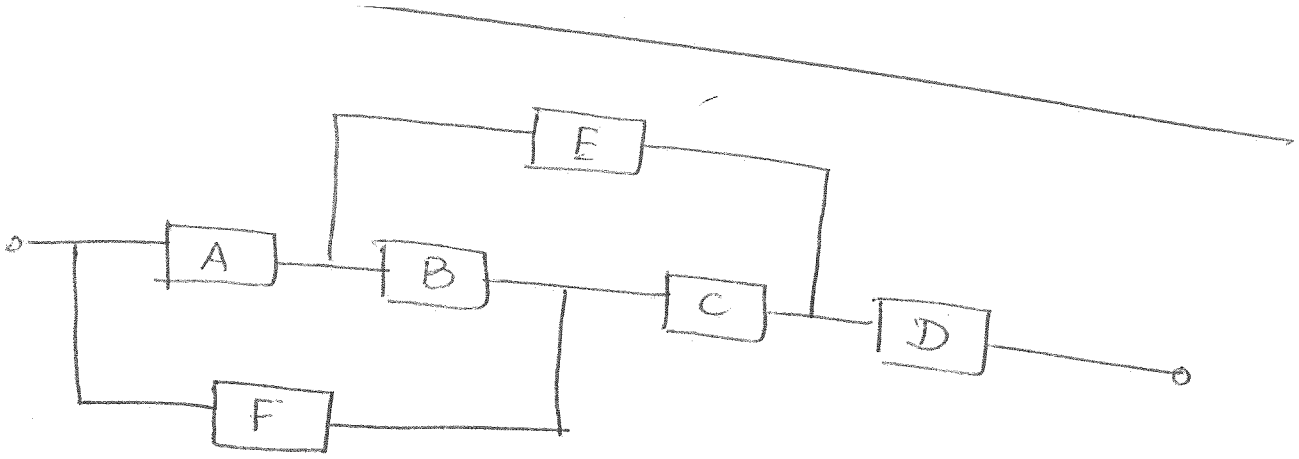
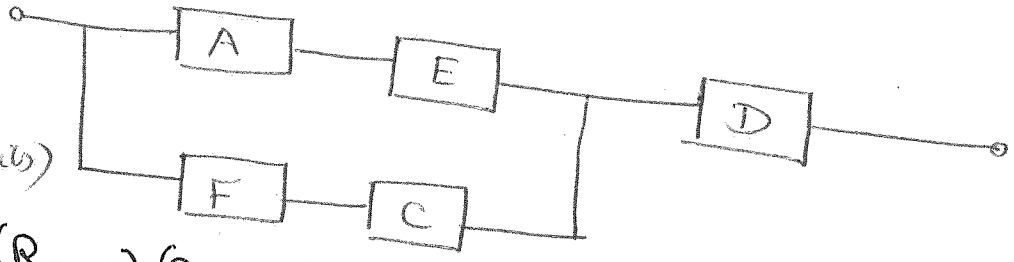


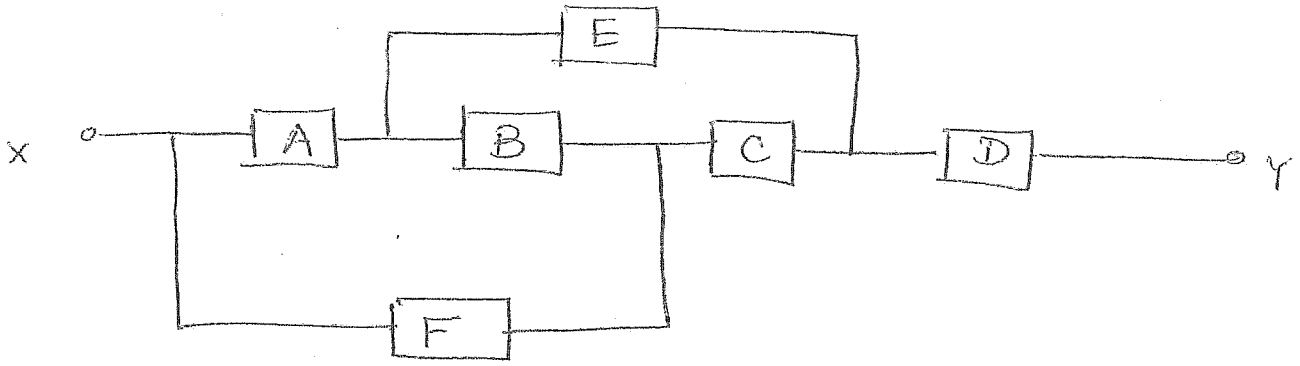
Case 1

B fails ("open")



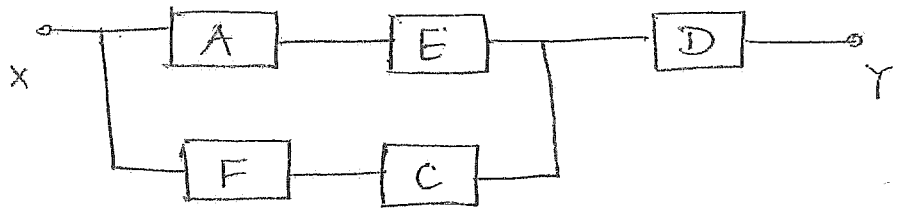
R_{sys} (B fails) $= [(R_{A+E}) \cdot (R_{F+C})]_{\text{for parallel}} \times R_D$

$= [1 - (1-(R_A \times R_E))(1-(R_F \times R_C))] \times R_D$



Case 1

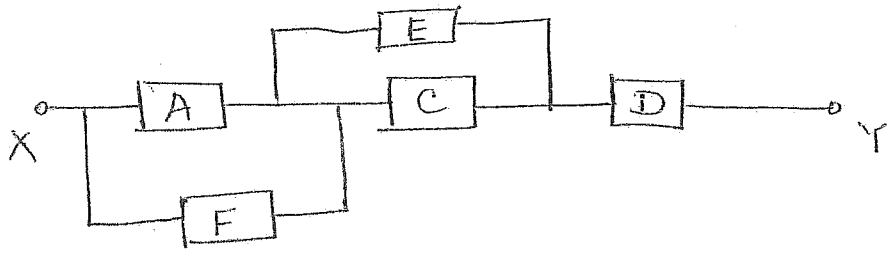
B fails ("open")



$$R_{sys|\,B\,fails} = \left[1 - (1 - R_A R_E)(1 - R_F R_C)\right] \cdot R_D$$

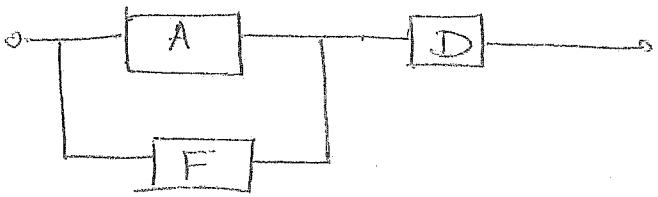
Case 2

B works ("shorted")



Case 2.1

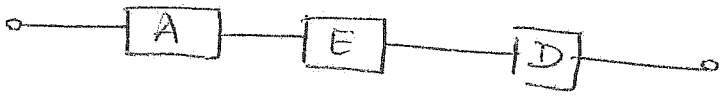
(B works), C works



$$R_{sys \mid B\ works,\ C\ works} = \left[1 - (1 - R_A) \cdot (1 - R_F)\right] \cdot R_D$$

Case 2.2

(B works), C fails

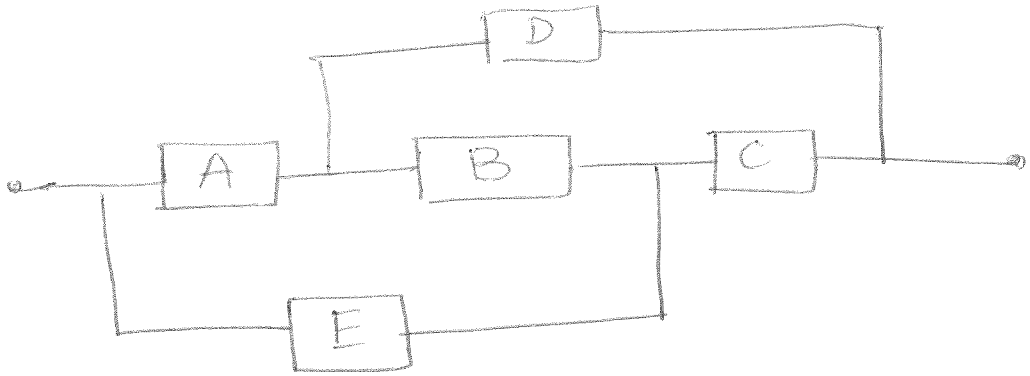


$$R_{sys \mid B\ works,\ C\ fails} = R_A \cdot R_E \cdot R_D$$

Putting it all together

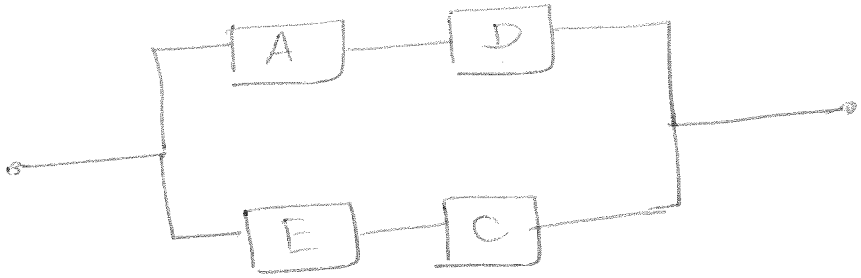
$$R_{sys} = R_B \cdot \left[R_C \cdot R_{2.1} + (1 - R_C) \cdot R_{2.2}\right] + (1 - R_B) \cdot R_1$$

Non series parallel system



Case 1

B fails

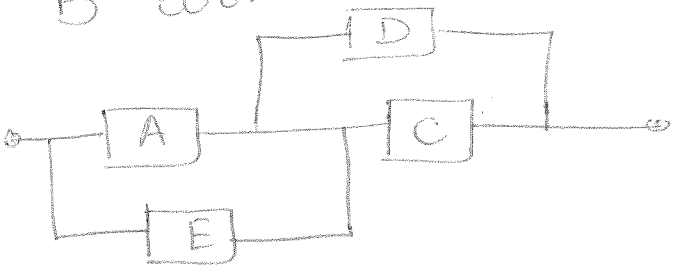


$$R_1 = 1 - (1 - R_A R_D)(1 - R_E R_C)$$

$$(1 - R_B) * R_1$$

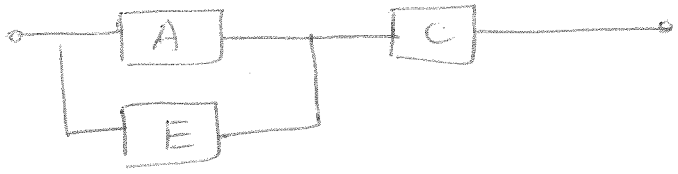
Case 2

B works



Case 2.1

D fails



$$R_{2-1} = \left[1 - (1-R_A)(1-R_E)\right] \cdot R_C$$

Case 2.2

D works

$$R_{2-2} = 1 - (1-R_A)(1-R_E R_C)$$

$$R_{sys} = (1-R_B) * R_1 + R_B * \left[(1-R_D) * R_{2-1} + R_D * R_{2-2}\right]$$

Dynamic Redundancy

Component	Reliability
C_1	0.95
C_2	0.90
C_3	0.85
⋮	⋮

Coverage (Detection + Localization) = 0.99

Coverage (Reconfiguration) = 0.99

Target reliability of System = 0.98

How many components do I need?

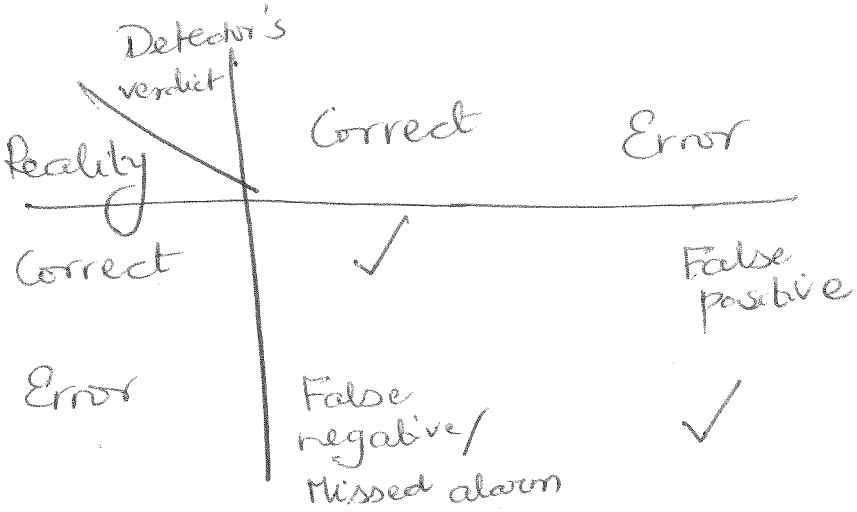
Option 1 $0.95 + 0.05 * (0.99 * 0.99) * 0.90 = 0.9941 > 0.98$

$\Rightarrow$ Need 2 components

Option 2 $0.95 * 0.99 + 0.05 * (0.99 * 0.99) * 0.90 * 0.99$

$= 0.9842 > 0.98$

$\Rightarrow$ Need 2 components


Detector's verdict
Reality
Correct
Error
Correct
✓
False positive
Error
False negative/ Missed alarm
✓