

Reliability evaluation of engineering systems

Problems

- 1 The system shown in Figure 4.14 is made up of ten components. Components 3, 4 and 5 are not identical and at least one component of this group must be available for system success. Components 8, 9 and 10 are identical and for this particular group it is necessary that two out of the three components functions

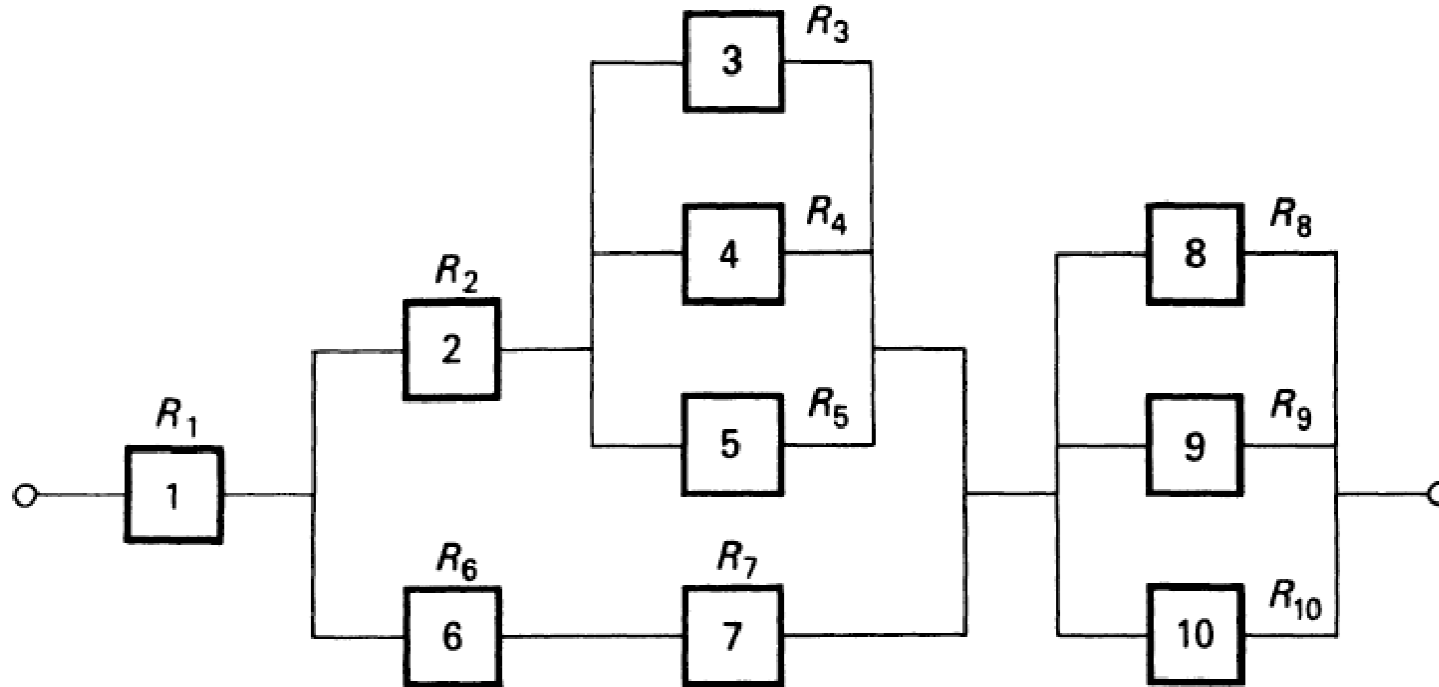


Fig. 4.14

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satisfactorily for system success. Write an expression for the system reliability in terms of the R values given. Also evaluate the system reliability if the reliability of each component = 0.8.

- 2 A system consists of four components in parallel. System success requires that at least three of these components must function. What is the probability of system success if the component reliability is 0.9? What is the system reliability if five components are placed in parallel to perform the same function?
- 3 A system contains two subsystems in series. System 1 has four possible operating levels, and System 2 has three possible operating levels as shown in the following table.

<i>System 1</i>		<i>System 2</i>	
<i>Output</i>	<i>Probability</i>	<i>Output</i>	<i>Probability</i>
100%	0.8	100%	0.7
75%	0.1	50%	0.1
25%	0.05	0%	0.2
0%	0.05		

Develop an operating level probability table for the system.

- 4 A series system has 10 identical components. If the overall system reliability must be at least 0.99, what is the minimum reliability required of each component?
- 5 A series system has identical components each having a reliability of 0.998. What is the maximum number of components that can be allowed if the minimum system reliability is to be 0.90?

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- 6 A parallel system has 10 identical components. If the overall system reliability must be at least 0.99, how poor can these components be?
- 7 A parallel system has identical components having a reliability of 0.5. What is the minimum number of components if the system reliability must be at least 0.99?
- 8 Write an expression for the reliability of the system shown in Figure 4.15.

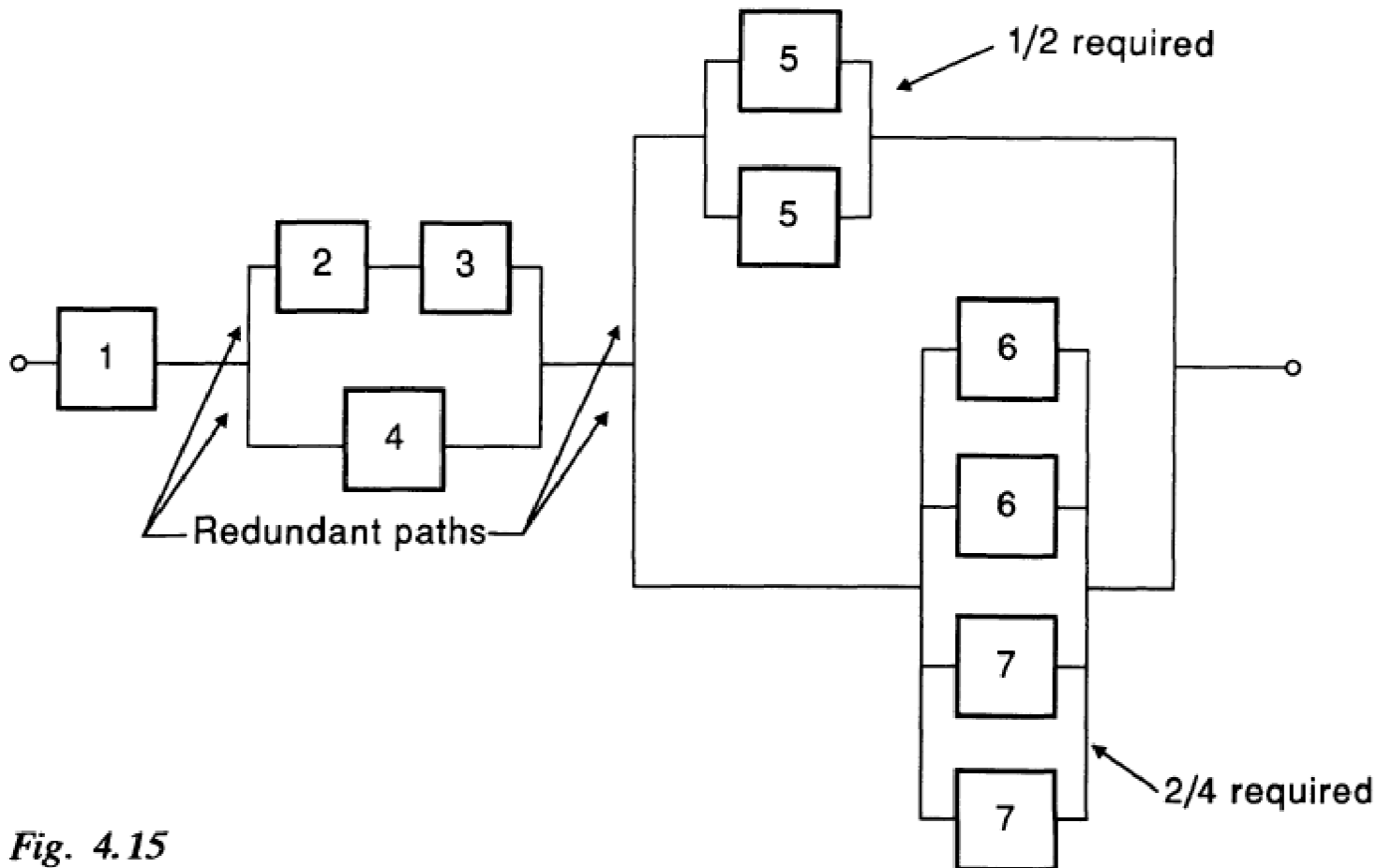


Fig. 4.15

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What is the system reliability if

$$R_1 = R_3 = R_5 = R_7 = 0.85 \text{ and } R_2 = R_4 = R_6 = 0.95?$$

- 9 Consider the reliability block diagram shown in Figure 4.16. System success requires at least one path of subsystem 1 and at least two paths of subsystem 2 to be working. Evaluate the reliability of the system if the reliability of components 1–6 is 0.9, the reliability of component 7 is 0.99 and the reliability of components 8–10 is 0.85. How many of these systems must be connected in parallel to achieve a minimum system reliability of 0.999?

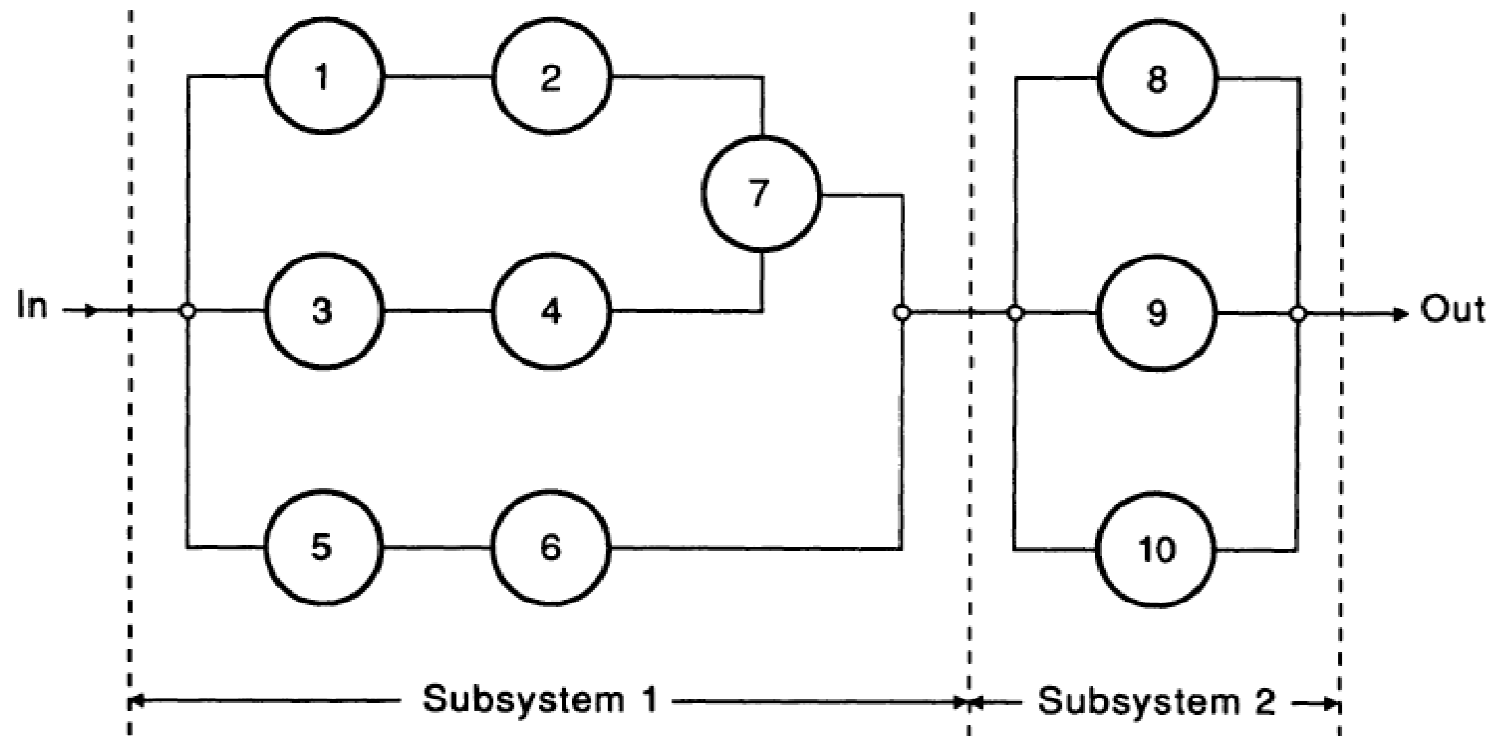


Fig. 4.16

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