



King Saud University
Department of Industrial Engineering
IE-434 Reliability and Maintenance Engineering
First Midterm Exam - Duration 90 min
Sun 8th of April, 2012; 16th of Jumada Al-Awal, 1433



Student Name :

Student Number :

Question 1 (5 Points)

A maintenance engineer in a shopping mall in Riyadh is concerned about the reliability of an escalator motor because it is at the end of its running life based on the available records. The motor has failure pattern with threshold time of 35,000 hours. The motor specifications show that the characteristic life of this type of motors is 10,000 hours. The shape factor of this motor may take one of the following values depending on the stage of failure rate (.5, 1, and 3.5)

Find the following:

1. What is the probability that the escalator motor would survive for next shutdown period (Eid Holidays) which is at 40,000 hours **(2 Points)**
2. What is hazard rate at 35,500 running hours? **(1 Point)**

On the other hand, the roller bearing of the escalator has constant MTTF estimated to be 85,000 hour:

3. What is the probability that the roller bearing would fail at during the period between 95,000 hours and 120,000 hours? **(2 Point)**

Question 2 (6 Points)

A system consists of 3 subsystems I, II and III as shown in Fig. 1, each of which has a constant failure rate as follows

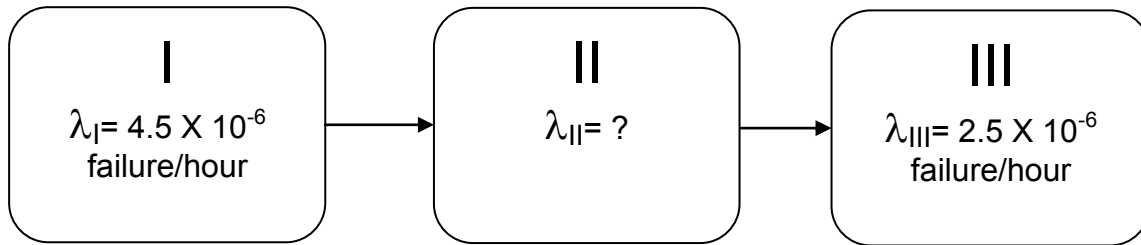


Fig. 1

1. If the reliability of the complete system at 56,000 hour is 54% , find the reliability of subsystems II alone at 70,000 hours **(3 Points)**

If the maintenance engineer proposes to improve the system reliability by replacing subsystem II with two identical subsystem I_A and I_B, both of constant failure rate where the system fails if both I_A and I_B fail.

2. Calculate the failure rate of each subsystem II_A and II_B to improve the system reliability to 60 % at 63,500 hours **(3 Points)**

Question 3 (4 Points)

A plastic injection molding machine consists of three subsystems (material hopper, injection ram and heating unit). The machine is running in a three-shift plant. The maximum allowed maintenance time is 45 min which is between shifts. Each one of the machine subsystems has its own failure rate and repair time as follows:

Subsystem	Failure Rate (failure/hours)	Repair Time
Material hopper	0.0025	25 min
Injection ram	0.005	15 min
Heating unit	0.004	10 min

1. What is the MTTR of the machine? **(1 Points)**
2. What is the probability that a repair of the machine will be performed within 45 min. **(2 Points)**
3. What is maximum allowed administrative delays if the MMD of the machine shouldn't exceed 45 min and the time to get the required material and spare parts is 12 min. **(1 Points)**