

Time : 3 hours

Max. Marks : 80

- 1) Attempt **any Four** questions
- 2) Assume additional data **if necessary** and state the same
- 3) Use of Statistical Tables and Certified Data Sheets is permitted

1. a) In a survival test conducted on 100 cardboard boxes for their strength under impact loading, the following results were obtained : **[10]**

No. of Impacts	20	22	24	26	29	32	35	37	40
No. of boxes failed	7	10	15	14	15	13	13	8	5

Determine Failure density, failure rate and reliability

- b) For the data given below two class frequencies are missing. **[10]**

Class Interval	100-110	110-120	120-130	130-140	140-150
Frequency	4	7	15	?	40
Class Interval	150-160	160-170	170-180	180-190	190-200
Frequency	?	16	10	6	3

The total number of frequencies are 150 and the median is 146.25. Find the missing frequencies.

2. a) The monthly worldwide average number of air plane crashes of commercial airlines is 3.5 : **[10]**
- a) Identify the distribution of number of air plane crashes.
 - b) What is the probability that;
 - i. There will be at least 2 such accidents in the next month.
 - ii. There will be exactly 4 such accidents in the next month.
 - iii. There will be atmost 3 such accidents in the next month.
- b) Distinguish between reliability and quality **[05]**
- c) Draw and describe five basic symbols in Fault Tree Analysis. **[05]**

3. a) A sample of 100 dry battery cells tested to find the length of life produced the following results : **[10]**

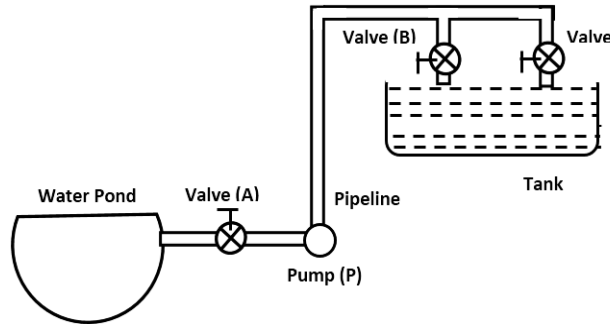
$$\bar{x} = 12 \text{ hours}, \sigma = 3 \text{ hours}$$

Assuming that the data are normally distributed, what percentage of battery cells are expected to have life

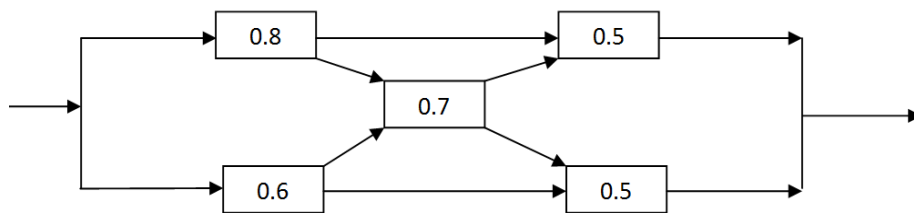
- i) more than 15 hours
 - ii) less than 6 hours
 - iii) between 10 and 14 hours
- b) The time to repair a power generator is best described by its probability density function $m(t) = \frac{t^2}{333}, 1 \leq t \leq 10$ hours: **[10]**
- (a) Find the probability that a repair will be completed in 6 hours.
 - (b) What is the MTTR
 - (c) Find the repair rate

Turn Over

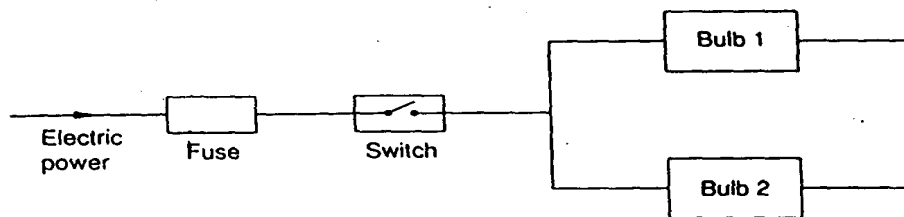
4. a) Consider a system shown in the figure consisting of three valves, a pump, a pipeline and a tank to collect water pumped from the pond. Construct a Fault Tree corresponding to the top event “No Flow of Water into the Tank”. [12]



- b) If 20 percent of the bolts produced by a machine are defective, determine the probability that out of 4 bolts chosen at random, [08]
- i) One bolt will be defective
 - ii) At most two bolts will be defective
- Use binomial distribution
5. a) Determine the reliability of the system as shown in the figure by the following methods: [14]
- a. Cut-Set Method
 - b. Decomposition
 - c. Enumeration Method



- b) Describe the Failure Mode Effect and Criticality Analysis (FMECA) procedure [06]
6. a) A room consists of two light bulbs operated by a single switch as shown in the figure below. Considering the initial event as the ‘room without electric light’, develop the event tree of the system [10]



- b) Explain the redundancy method to improve Reliability of system. [05]
- c) Explain the Bath tub curve in Reliability Engineering. [05]