

(3 Hours)

[Total Marks : 80]

- N.B. 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
 4) Figures to the right indicate full marks

1. a) Estimate the probability of at least 4 candidates passing an examination in a group of 6 candidates, if the overall percentage of failures is 40. Use binomial distribution. [10]
 b) A life test on electric bulbs was conducted by a company. The results of the test are tabulated below : [10]

No. of bulbs	3	10	20	30	15	10	10	2
Time in hrs for failure	1000	1200	1500	2000	2200	2500	2700	3000

Estimate :

- (i) No. of survivors, failure density and failure rate at each interval
 (ii) Mean Time to Failure
 (iii) Reliability of the bulbs for 1500 hrs and 2500hrs of operation. Assuming constant rate of failure.
2. a) The quantity of engine oil in the engine have a normal distribution with mean of 500ml and SD of 5ml. What percentage of engine will have engine oil fall : [10]
 a) Below 498ml
 b) Above 504ml
 c) Below 498ml and above 504ml
 d) Between 498ml and 504ml
- 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

3. a) Identify the two missing class frequencies from the frequency distribution table below. [12]

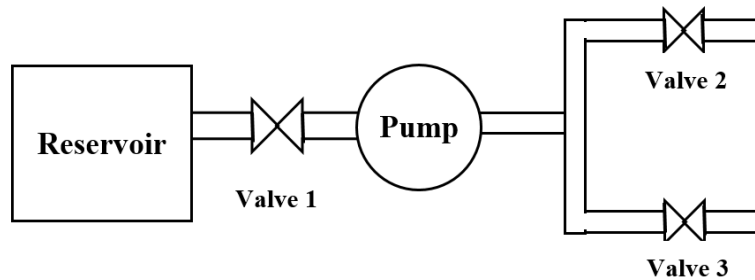
Class Interval	100-110	110-120	120-130	130-140	140-150
Frequency	4	7	15	?	40
Class Interval	150-160	160-170	170-180	180-190	190-200
Frequency	?	16	10	6	3

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

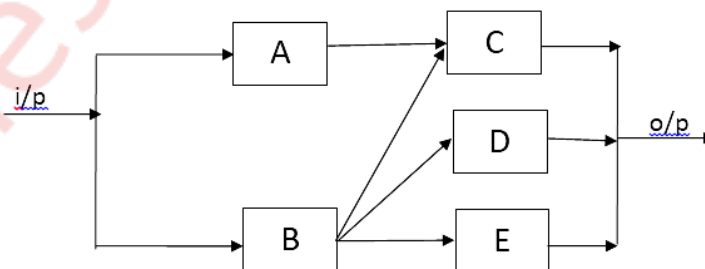
- b) Illustrate any one method for Reliability Improvement [04]
 c) Describe with neat sketch the Bath tub curve in Reliability Engineering [04]

P.T.O.

4. a) Figure shows a typical reactor coolant system that is required to pump coolant from a reservoir in the case of 'Loss of Coolant Accident' (LOCA). The coolant from the reservoir is controlled by valve 1 and is pumped through two parallel segments via the valves 2 and 3. Considering LOCA as the initial event, develop the FAULT TREE of the system. [10]



- b) Domestic hot water boilers make use of thermal switches to control the temperature of the water. In order to provide protection against malfunctioning of the thermal switches, either blow-out valves or vent pipes can be provided. Assume a situation where a boiler is provided with a thermal switch and a blow-out valve. The heating elements inside the boiler may or may not be working. Construct a suitable EVENT TREE model considering top event as 'Failure of Boiler'. [10]
5. a) Two fuel pumps each having Weibull failure distribution with $\beta = \frac{1}{2}$ and $\theta = 1000$ hrs are configured to provide a redundant system. Find the system reliability for a 100hr mission and the system MTTF. [10]
- b) Distinguish between Repair and Replacement [05]
- c) With neat sketch explain the five basic symbols in Fault Tree Analysis. [05]
6. a) Determine the reliability of the system as shown in the figure by the following methods: [14]
- Cut-Set Method
 - Decomposition
 - Enumeration Method



$$R_A = R_B = 0.9$$

$$R_C = R_D = R_E = 0.8$$

- b) Describe the procedure for Failure Mode Effect and Criticality Analysis (FMECA). [06]