# Question Paper Code : 6395

**M.Sc. (TQM) (Sem.-IV) Examination, 2018**

## STATISTICAL APPLICATIONS-RELIABILITY MAINTAINABILITY & AVAILABILITY

### [Third Paper]

**Time : Three Hours]**        **[Maximum Marks : 70**

**Note :** Answer **five** questions . Question **No. 1** is **compulsory**. Choose **one** question each from four units.

1. Explain briefly and give examples, wherever possible:[30]

    (a) Define reliability.

    (b) Explain life cycle of a product -Weibull distribution is largely used for studying the various phases of life cycle. What are the values of shape parameter ($\beta$) for different phases.

    (c) Two components A and B with reliability of 0.95 and 0.90 are connected in parallal. Calculate the reliability. Also find out reliability of the system if reliability stated for component 'A' and 'B' is for 600 hrs of operation.

(d) Distinguish between Failure Terminated Test and Time Terminated Test for testing the reliability.

(e) For exponential distribution with a failure rate of $\lambda$, write down the expressions for $f(t), F(t), R(T) \text{ and } r(t)$.

(f) Discuss the design guidelines for improving the maaintainablity of a product.

(g) Features and working of sequential reliability test.

(h) Explain Operational and Inherent availability of a system.

(i) MTTR and MTTF trade-off with an exmaple.

(j) A system is using an assembly whose failure rate is 0.005/hr. Two such assemblies are kept as spares. Calculate the probability that a spare assembly will be available for next 400 hrs of operation.

**UNIT-I**

2. The time to repair an equipment is exponentially distributed with a mean of 20 minutes. Calculate : [10]

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Given :

$$\lambda_A = 0.005/hr, \lambda_B = .005/hr \ \lambda_c = 0.003/hr$$

$$\lambda_D = 0.001/hr, \ \lambda_E = .003/hr, \lambda_F = .008/hr$$

$$\lambda_G = 0.005/hr, \lambda_H = .006/hr$$

Calculate reliability of system for 500 hrs. Calculate MTTF.

(b)  Refer to Q. No. 7 (b). The test should be terminated at 600 hrs. Calculate the sample size and acceptance number using Hardbook (H-108). The failed items are replaced.

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(a)  Probability of repair within one hour.

(b)  If the machines breakdowns at 4 pm. and the repairman starts repair immediately, what is the probability that the machine will be available for production by the start of next day. Assume that the repairman is available upto 7 pm.

(c)  Standard deviatiion of the repair time.

3.  The time to failure of an item can be described by a Weibull distribution with location parameter=0, shape Parameter=0.5 and scale parameter 600 hrs. Find: [10]

(a)  Mean time to fail.

(b)  Standard Deviation of the time to fail.

(c)  Probability of the component lasting for 1000 hrs.

**UNIT-II**

4.  (a)  An equipment has 5 components in series. Each component has an exponential time to failure distribution with failure rate of 0.10 per 4000 hrs. Find out. : [10]

(i)  Reliability of component for 2000 hrs.

(ii)     Reliability of the unit for 1000 hrs.

(iii)    Mean Time to fail for the unit.

(b)     Write short note on Total Productivity .

5.  (a)  Refer to Q. No. 4 (a) . It is desired that the unit has a reliability of 0.99 for 2500 hrs. Calculate the mean time to failure required for each component.

(b)     Write short note on Integrated Logistic Support.

### UNIT-III

6.  (a)  A sample of 20 items are chosen for life testing. The failure is terminated at sixth failures ( with failed items replaced ). The failure times are 530, 600, 640, 700, 750, 780 hr. Find the MTTF of the items. Find 95% confidence interval for MTTF.

(b)     Find a failure terminated testing plan (using Handbook H-108) that rejects lots with MTTF of 1800 hrs with a probability of 0.05 and rejects lots with MTTF of 600 hrs with a probability of 0.10. Calculate the criteria for acceptance of lots.
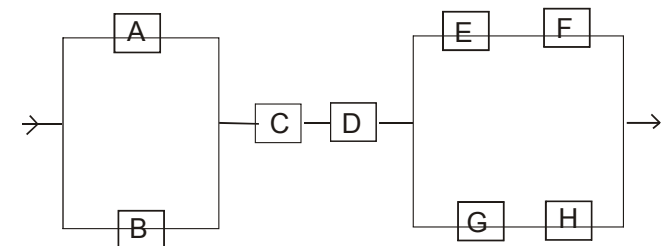
7.  (a)  Refer to Q. No. 6 (a) . The test is terminated at 800 hrs. Six (6) items have failed at times given in Q. No. 6(a). The failed items are replaced. Find 90% confidence interval for MTTF of the item. The sample size should be smallest possible.

(b)     Refer to Question No. 6 (b) Calculate the criteria for acceptance of lot for Time Terminated Test (with replacement) as per Hard Book H-108. The sample size chosen should be smallest as the items are costly.

### UNIT-IV

8.  Find out the acceptance line and rejection line for a sequential testing plan. $\theta_0 = 1400, \alpha = 0.05, \theta_1 = 600\,hrs$ with $\beta = 0.01$. Give the acceptance criteria for failure numbers 0, 1 and 2.

9.  (a)  Consider a system shown below :          [10]