

Total No. of Questions : 4]

SEAT No. :

PE-284

[Total No. of Pages : 3

[6580]-652

B.E. (Robotics & Automation) (Insem.)
ROBOT SYSTEM RELIABILITY AND SAFETY
(2019 Pattern) (Semester - VII) (411502)

Time : 1 Hour]

[Max. Marks : 30

Instructions to the candidates:

- 1) *Figure to the right indicates full marks.*
- 2) *Neat Diagrams must be drawn wherever necessary.*
- 3) *Assume Suitable data if necessary.*
- 4) *Use of Logarithmic Table, Slide rule is Electronic pocket calculator is allowed.*
- 5) *Solve Q.1 or Q.2, Q.3 or Q.4.*

Q1) a) Derive an expression for Hazard Rate Function for a random variable time 't'. such that this function is dependent on the reliability function and failure distribution function. Assuming the failure rate is not constant but as a function of 't'. **[8]**

b) Derive an expression for Mean Time to Failure with respect to reliability function. Assuming the failure rate is constant. **[7]**

OR

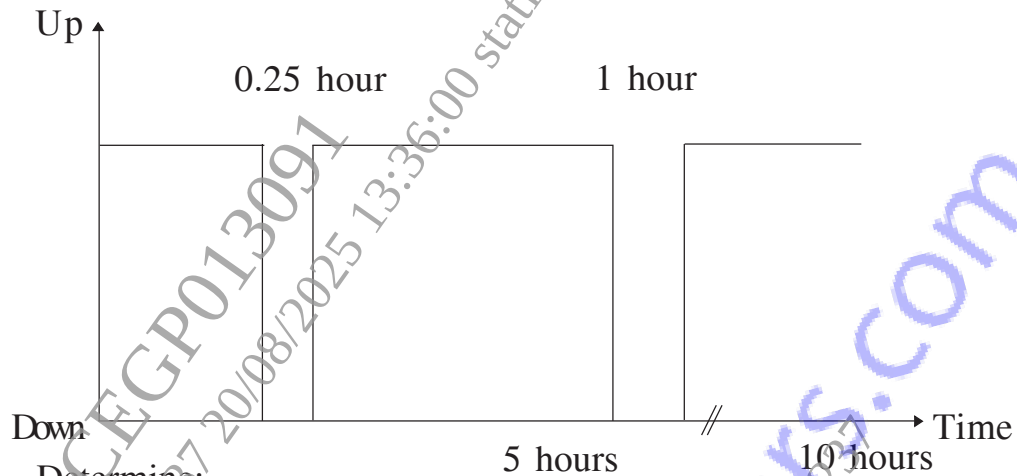
Q2) a) The failure data of the robotic system of 500 components is shown below:

OperatingTime (in months)	0-10	10-20	20-30	30-40	40-50
Number of failures	167	116	90	72	55

Estimate and plot the reliability, failure density and failure rate functions with respect to time. **[8]**

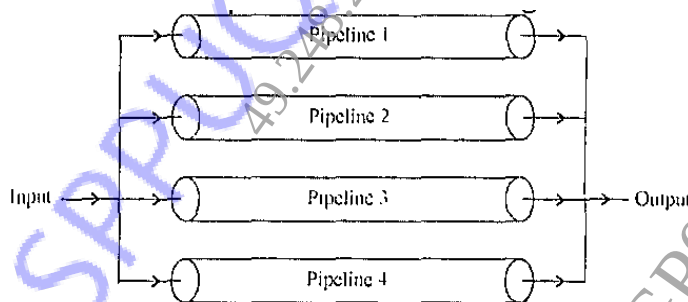
P.T.O.

- b) The figure below shows the pattern of uptime and downtime of a robotic actuation system: [7]



Determine:

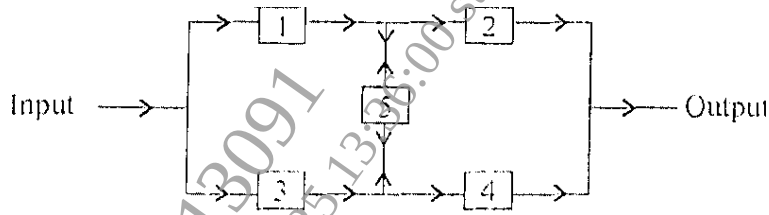
- MTBF
 - MTTR
 - Availability
 - Availability trade off condition and plot the graph between Mean Time To Repair (MTTR) and Mean Time Between Failure (MTBF) for this condition.
- Q3) a)** Derive an expression for reliability of a system in series with respect to failure rate. Assuming the failure rate is constant. [8]
- b) Consider a hydraulic piping system having 4 pipelines for the robotic actuation are connected in parallel as shown in figure below: [7]



Assume that all pipes are independent. It is given that the reliability of 4 pipelines for a mission of 1000 hours are $R_1 = 0.60$, $R_2 = 0.70$, $R_3 = 0.80$ and $R_4 = 0.75$, respectively. Evaluate the reliability of the 2-out-of-4 system.

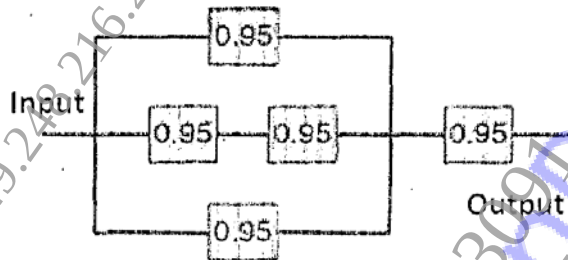
OR

- Q4) a)** Using the tie set method, evaluate the reliability of the system, which has the reliability block diagram shown in figure below for a mission of 1000 hours



It is given that each component has reliability of 0.95 for a mission of 1000 hours. Assume that the components are independent. [8]

- b)** Given the following diagram below: [7]



Determine the total reliability of the system.