Total No. of Questions : 8]

SEAT No. :

P7845

[Total No. of Pages :4

[6181]-384

B.E. (Robotics & Automation)

ROBOT SYSTEM RELIABILITY & SAFETY

(2019 Pattern) (Semester-VII) (411502)

Time : 2 ½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Figure to the right indicates full marks.***
3) ***Assume suitable data, if necessary.***
4) ***Use of Logarithmic Table, slide rule and electronic pocket calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Apply the AGREE allocation method to a robotic system containing the following components: **[8]**

Component = C. Parts count= PC Importance index= IND Operating time hr/yr = OT

C: Control System. PC: 153 IND: 0.95 OT: 2000

C: Motor drive. PC: 28 IND: 0.90 OT: 1000

C: Actuation System PC: 34 IND: 1.00 OT: 2000

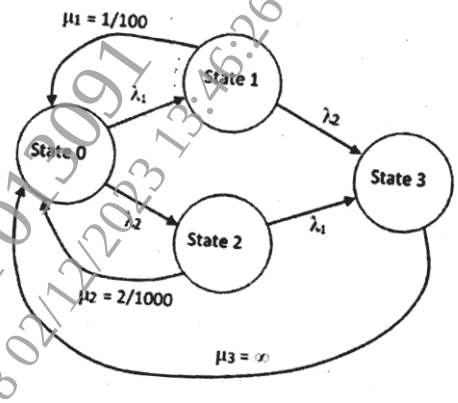
The warranty program requires a reliability of 0.99 over the first year of use.

b) A computer used for controlling robot consists of three sub- system having consecutive failure rates λ_1=0.015, λ_2=0.018, λ_3=0.023 failures per month. Select the requirements of reliability through 36 months in service to achieve total reliability it as 0.98 using ARINC Method of Reliability Allocation. Also, check if the total reliability goal of computer is achieved. **[9]**

OR

P.T.O.

Q2) a) A two-element system model is subjected Markov Analysis having the block diagram given below: **[8]**

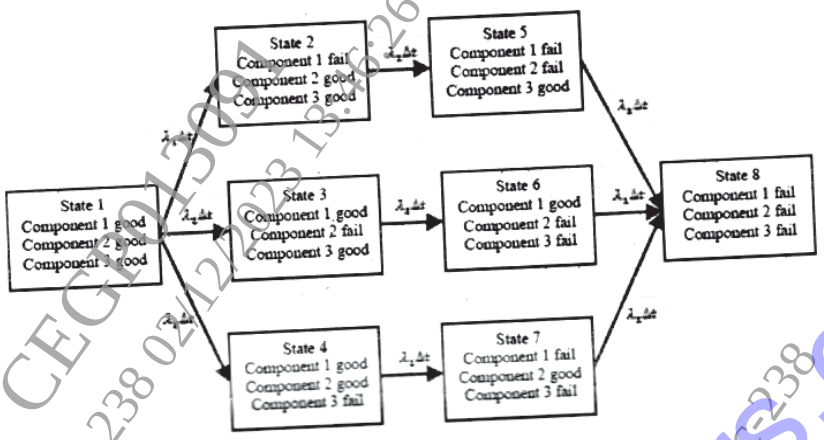


Derive an expression of reliability for this system assuming the elements are independent and are parallel.Also, find the reliability if λ_1 =50E-06 failures per hour, λ_2 = 20E-06 failures per hour, μ_1= 1/100 repairs per hour, and μ_2=2/1000 repairs per hour.Consider the steady state transition throughout the system.

b) Optimize and allocate the reliability of a robot motors for 4 axis articulated robot using Minimum Effort Method, if cost of all motors should not exceed €8000: **[9]**

Joint	Component Feasibility	Initial Reliability	Minimum Reliability	Maximum Reliability	Per unit cost
J_i	f_i	R_i	$R_{i,min}$	$R_{i,max}$	C_i
1	0.68	0.985	0.9	0.999	30
2	0.66	0.985	0.9	0.999	30
3	0.66	0.985	0.9	0.999	40
4	0.64	0.98	0.9	0.999	40

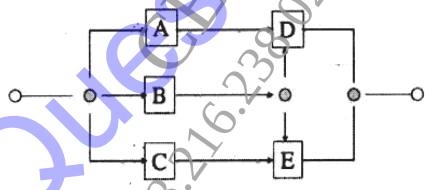
Q3) a) Find expression of system probability at each stage using Markov Analysis Method for the 3-unit system having following transition state diagram: **[12]**



b) Explain Markov Analysis Model for Reliability. **[6]**

OR

Q4) a) Consider below System. Use event space method and find an equation for the reliability of the system if all chunks are identical and independent. **[9]**



Find the reliability of the following system if the probability of success of each component is 0.8.

b) Explain the Minimum Effort Method of Reliability Allocation. **[9]**

Q5) a) Define Risk. Explain various .perceptions, criteria, management method and estimation of risk. **[9]**

b) Explain in details the lead and lag indicators of the hazard control. **[9]**

OR

Q6) a) If sampling was conducted for a worker working with for air contaminant containing heptane for two cases as below: **[9]**

Case-1 The worker worked for seven hours and the concentration for that seen hour was 500 parts per million (ppm) for a shift of 8 hours.

Case-2 The worker worked for one workspace for 2 hours with 100 ppm exposure and in another workspace for 3 hours with 200 ppm for a shift of 8 hours.

Find time weighted average for both the cases according to OSHA specification. Also check is this exposure is within the safe range if safe range of time weighted average for heptane is 400 ppm as per OSHA.

b) Explain in detail about ISO45001: 2018. **[9]**

Q7) a) Differentiate between Unsafe Condition and Unsafe Act with relevant examples and case study. **[8]**

b) Explain RULA and REBA to evaluate musculoskeletal disorder. **[9]**

OR

Q8) a) Explain various kinds of hazards and what are the various methods to avoid, control and measure such hazards. Explain with relevant case study. **[8]**

b) Explain various methods of Preliminary Hazard Analysis or Risk Assessment. Use relevant case studies to explain various methods. **[9]**

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