QUESTION #3 (CLO-2, C4) [10]

a) Figure out the following expression for the waiting time (in system) distribution in an M/M/1 queuing system:- [4]

$$W(t) = e^{-(\mu-\lambda)t}, \ t > 0$$

b) On a network gateway, measurements show that the packets arrive at a mean rate of 180 packets per second (pps) and the gateway takes an average of 2.5 milliseconds to forward them. Both the inter-arrival and service times are following exponential distribution. Figure out the following quantities using appropriate queuing model:- [6]

i. Probability of more than two packets in the systems
ii. Average packet transmission delay (in msec)
iii. Average queuing delay for each packet (in msec)
iv. Average number of packets in the system
v. Average number of packets waiting to be transmitted
vi. 90^{th} percentile waiting time in the system

QUESTION #4 (CLO-3, C4) [10]

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]=-

percentile waiting time in the system

QUESTION #4 (CLO-3, C4) [10]

a) The computing facility of a pharmaceutical company has a single printer. The print jobs arrive at random according to a Poisson process at an average rate of 12 every 5 minute. It has also been estimated that the number of pages in the documents range from 1 to 12, uniformly distributed. The printer takes a fixed time of 3 seconds for printing one page. [3]

i. Confirm that the system would attain a steady-state.
ii. Figure out the average number of requests in the queue.

Date

$\lambda = \frac{1}{15}$ jobs/sec

$a = ?$, $b = ?$

$a = 2.5$, $b = 2.5 \times 10 = 25$

$\frac{1}{\mu} = \frac{a+b}{2} = \frac{2.5+25}{2} = 13.75$

$\Rightarrow \mu = 0.0727$ job/sec

$\sigma^2 = \frac{(b-a)^2}{12} = \frac{(25-2.5)^2}{12} = 42.1875$

1) System attain ss = ?

$\rho = \frac{\lambda}{\mu} = \frac{1/15}{4 \cdot 0.0727} = 0.9170 < 1$

System attain s.s

2) $P_0 = 1 - \rho$

$P_0 = 1 - 0.9170 = 0.0829$

3) Avg backing for Printer = L_q = ?

$L_q = \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{(1/15)^2}{\mu(0.0727 - \frac{1}{15})} = \cancel{0.73664}$?

1) ss Result = ?

~~W =~~ $L = \rho + L_q$

$L = 0.9170 + 0.73664$

$L = 1.65364$

$W = L/\lambda = 1.65364/(1/15) = 24.8046$

$W_q = L_q/\lambda = 0.73664/(1/15) = 11.0496$

i. Construct the (one-step) transition ...

ii. Calculate the steady-state probabilities of the state of this Markov chain. [1.5]

In an M/M/3 system, jobs arrive at the rate of 12 jobs/sec. Calculate the service rate (jobs/sec) beyond which the system would remain stable. [1.5]

...nstruct kendall's notation (in most simplified form) for a queuing process having deterministic ...arrival and exponential service times, three parallel servers, with only 100 out of virtually infinite ...er of customers allowed in the system and FCFS queue discipline.

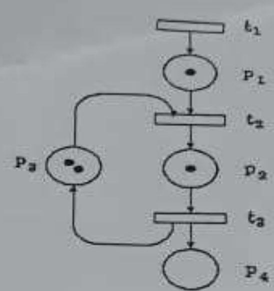
QUESTION #6 (CLO-3, C4) [12]

a) Identify suitable notion for following blanks:- [3]

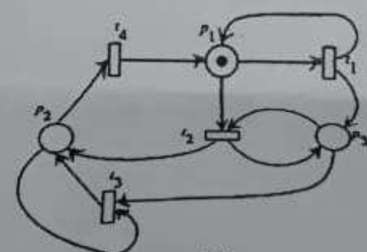
i. Petri nets are used for modeling ________ behavior of concurrent systems.
ii. A marking defines the number of ________ in each place of the Petri net.
iii. A Petri net is ________ if there are no transitions in the net that are enabled.
iv. A PN is safe if each ______ is safe.
v. In a timed-PN, a transition fires once the timer reaches ________.
vi. In ________ firing semantics, as soon as the transition is enabled, it removes its enabling tokens from the input places.

b) Diagram a simple PN in which transition fires only when there are less than n items in the input place. [1]

c) Following PN models a finite buffer. Briefly explain its operation by highlighting the function of each place and transition. [2]



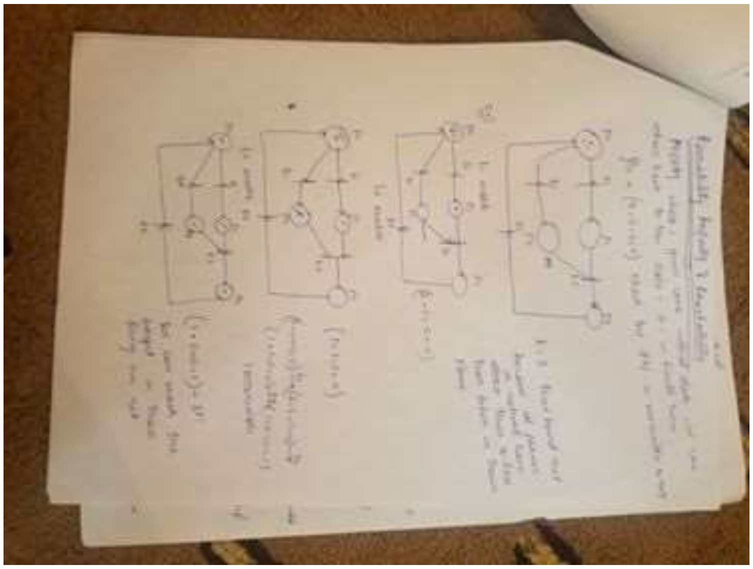
d) Consider a Petri net with initial marking as shown below:- [3]



Use matrix analysis to select Petri net marking subsequent to the sequence of following transition firings: $t_1 \rightarrow t_2 \rightarrow t_3 \rightarrow t_4 \rightarrow t_1 \rightarrow t_2 \rightarrow t_3$.

Consider a multiprocessor system with no. of processors, N=2 and no. of memory modules, M=2. [3
Let the vector K represents the system state in terms of requests for each memory module and vector G represents a new feasible system state. Now using the general formula, figure out the state transition matrix P and outline the state transition diagram.

* * * * *



suitable examples. [3]

c) Compute the following integral using the Monte Carlo simulation (use six iterations):-

$$I = \int_2^5 x^3 dx$$

[2]

Requests for a page at a web server arrive randomly, every 3 milli-secs on the average, following negative-exponential distribution. Apply the Inverse Transformation method algebraically, to select three random observations for time-period-until-next-arrival of requests (in milli-secs) by using the following uniform random numbers: 0.1765, 0.4097 and 0.9132.

QUESTION #4 (CLO-3, C4) [10]

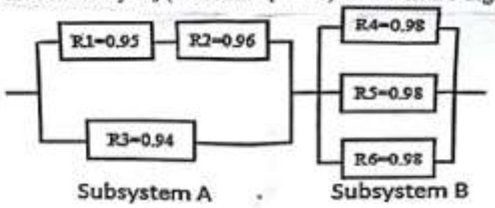
a) The computing facility of a pharmaceutical company has a single printer. The print jobs arrive at random according to a Poisson process at an average rate of 12 every 5 minute. It has also been estimated that the number of pages in the documents range from 1 to 12, uniformly distributed. The printer takes a fixed time of 3 seconds for printing one page. [3]

i. Confirm that the system would attain a steady-state.
ii. Figure out the average number of requests in the queue.

b) Explain that system faults do not always result in failures using any two reasons. [2]

c) Outline the taxonomy of software reliability models. [2]

d) A digital system has six components with following interconnection. The subsystem B is a *2-out-of-3* configuration. Figure out the reliability R_s (4 decimal places) of the entire digital system. [3]



QUESTION #5 (CLO-1, C3) [10]

a) The distribution of the equivalent classes of input and results of test cases for each class are given below:- [2]

Equivalent Class (E_i)	P_i	n_i	f_i
E_1	30%	40	3
E_2	35%	50	4
E_3	35%	50	2

Calculate the reliability (4 decimal places) of the given software based on Equivalent Class Reliability model.

b) Provide the meaning of trace in trace-driven simulation. Express its main purpose along with two suitable examples. [3]

c) Compute the following integral using the Monte Carlo simulation (use six iterations):- [3]

$$I = \int_2^5 x^3 dx$$

d) Requests for a page at a web server arrive randomly, every 3 milli-secs on the average, following negative-exponential distribution. Apply the Inverse Transformation method, algebraically, to select three random observations for time-period-until-next-arrival of requests (in milli-secs) by using the following uniform random numbers: 0.1765, 0.4097 and 0.9132. [2]

CS-045

QUESTION # 2

(a) A system that monitors patients in a hospital intensive care unit.

Metrics: metrics used here should be availability because monitoring patients should be a non-stop continuous system that needs to be available 24/7.

Let Avail = 0.997 which means system should be available 997 times out of 1000

(b) A word processor

Metrics: MTTF should be used.

because word processor generally used for longer transactions.

Let MTTF = 100 means one failure expected every 500 time units.

(c) A flood warning system to give early warning of flood dangers to sites threatened by floods.

Metrics: POFOD should be used

because it is a sort of protection system that alerts people about flood danger on early basis

Let POFOD = 0.001 (one failure out of 1000)

(d) Book issuence system at a library.

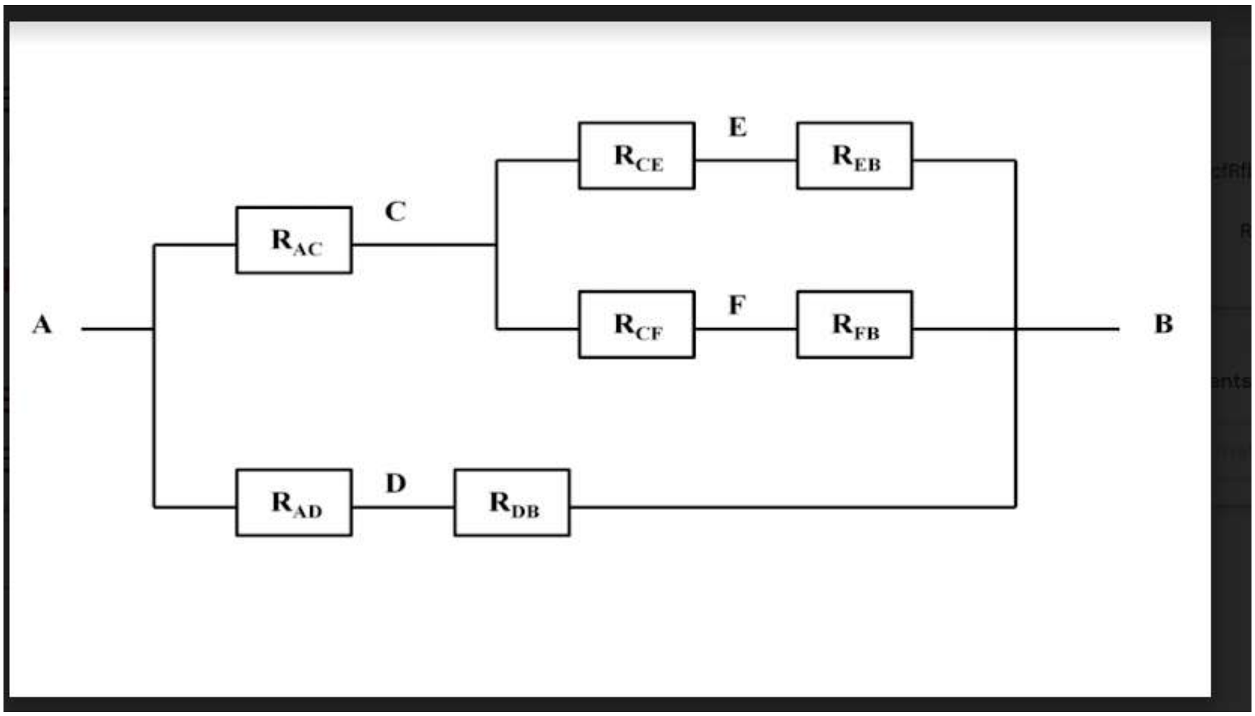
Metrics: ROCOF should be used.

Here regular demands are made and it is required that the service is delivered well and correctly.

Suppose a ROCOF of 2/100 means 2 failures likely to occur in each 100 operational time units.

Determine why the failure rate is at its peak at the beginning of Infant Mortality phase and eventually decreases with time ?

Consider the reliability block diagram in the figure attached. a) Derive the Reliability Expression. b) Assume homogeneous modules and value of R = your roll no/100, calculate the probability that overall system is reliable and data transmission is possible from point A to B.



1-[1-RceReb][1-RcfRfb][Rac] R=19/100= 0.19 Put this value in above equation Ratob=0.8234

SECTION “B”

An electrical supply system is subject to failure which causes loss of supply to the consumer. The mean time between such failures is known to be 398 hr and the meantime to repair the failures and restore the supply is known to be 2 hr. Compute the value of the availability of supply to the consumer?

A=MTTF/(MTTF+MTTR) A=398/(398 + 2)

Consider a system that contains four components with reliability functions given respectively by $R1(t) = \exp(-\alpha t)$, $R2(t) = \exp(-\beta t)$, $R3(t) = \exp(-\gamma t)$, and $R4(t) = \exp(-\delta t)$

What is the reliability function of the system that has these four components arranged

(a) in series and (b) in parallel?

(c)A different system arranges these components so that the first two are in series, the last two are in series, but the two groups of two are in parallel with each other. What is the reliability function in this case?

Fakhra Aftab • Jul 9 (Edited Jul 9)

3)Rsystem=1-[(1-[exp(−αt) * exp(−βt)])* (1-[exp(−γt)*exp(−δt)])]

2)rp=1-[(1-exp(−αt)) *(1- exp(−βt))* (1-exp(−γt) *(1- exp(−δt)

Provide at least two application areas of highly reliable systems.

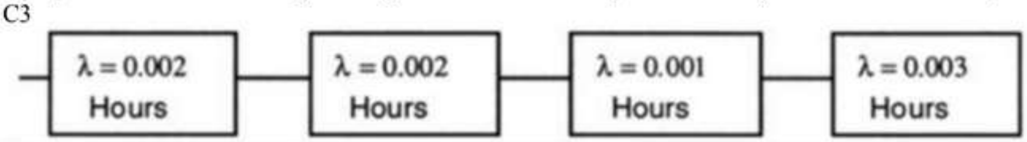
Cs-099

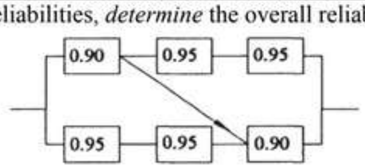
Q1)

Given $D^{-2} * D^{+1} = \begin{bmatrix} 1 & 2 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix}$, $D^{+2} * D^{-1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ and $D = \begin{bmatrix} 0 & -2 & -1 & 0 \\ 0 & 2 & 2 & -1 \\ 0 & 0 & -1 & 1 \end{bmatrix}$

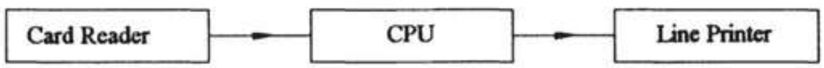
Draw the Petri net model.

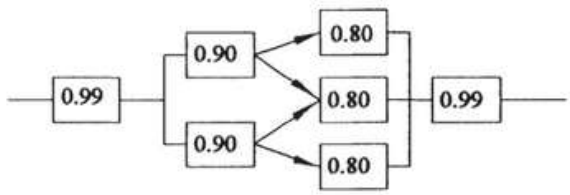
Q2) Q1) If M' = [1 3 0 0] and M = [1 0 1 0]. Find out the firing sequence (σ).

	probability that at least three components will fail in the next twenty days.	
Q5	The components in the system below are exponentially distributed with the indicated failure rates. *Derive* an expression for the reliability of the system. *Determine* the system reliability at time = 100 hours? (CLO1, C3 	03

Q9	Given the following component reliabilities, *determine* the overall reliability of the system. (CLO1, C3) 	03

A system consists of four components. If more than two of the components fail, the system fails. If the components have an exponential time-to-fail distribution with a failure rate of 0.000388, calculate the reliability of the system at time = 300. Determine the overall system's mean time to fail. (CLO1, C3)

Q9	A computer system has three units as shown in Fig. Their reliabilities are as follows: Card reader = 0.89 Central processing unit (CPU) = 0.98 Line printer = 0.85  *Determine* the system reliability. If you want the system reliability to be not less than 0.95, provide the steps you would take. *Draw* the improved system diagram and calculate its actual reliability. (CLO1, C3)	03
Q10	*Identify* different characteristics of LinPack & TCP benchmarks. (CLO3, C4)	02

Q9	Given the following component reliabilities, *calculate* the overall reliability of the system. (CLO1, C3)  	03