**Simulation**　　　　　　　　　　　**University of the Ryukyus**
**3-rd Year Undergraduate**　　　　　**Faculty of Engineering**
**Mid-Term Examination**　　　　　　**Department of Information Eng.**
**2004-1-5　　time: 90 minutes　(score: each 10)　Prof. Mohammad Reza Asharif**
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*1- In M/M/1 queue, explain the events and the state variables.*

*2- Explain simulation clock and two approaches for the simulation clock advancing.*

*3- What is the Monte Carlo simulation.*

*4- What is iconic model?*

*5-Find the value of the following integral by using Monte-Carlo method and compare with the true value of the integral (use 11 points as shown in the table).*
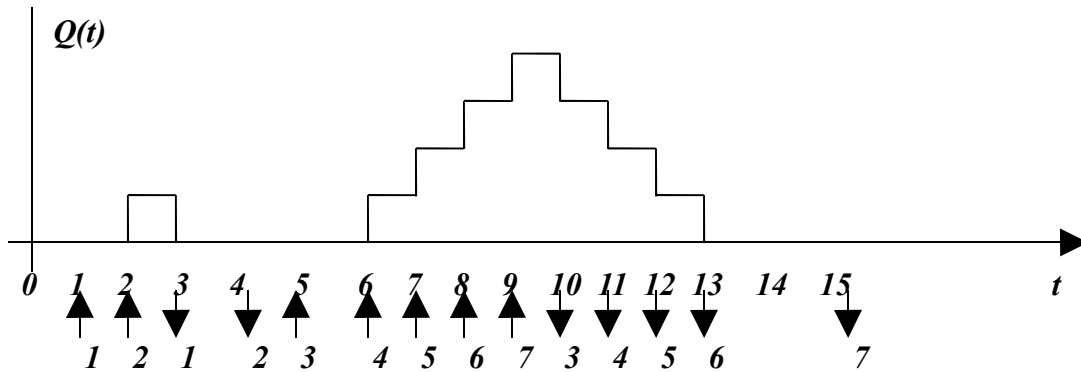
$$I= \int_{0}^{2} x^3 dx$$

| i | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 0 | 11 |
|------|---|-------|-------|-------|-------|---|-------|-------|-------|-------|---|
| xi | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 |
| xi^3 | 0 | 0.008 | 0.064 | 0.216 | 0.512 | 1 | 1.728 | 2.744 | 4.096 | 5.832 | 8 |

**6-In the following single server queuing system, find:**
   **a) Average delay in queue.**
   **b) Average number of customers in the queue.**
   **c) Efficiency of utilization of the server.**

( ↑ i means ith arrival) *(n=7)* ( ↓ i means ith departure)

**Q(t)**



0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15   *t*

↑ ↑ ↓  ↓ ↑  ↑ ↑ ↑ ↑  ↓ ↓ ↓ ↓        ↓

*1  2  1    2  3    4  5  6  7  3  4  5  6        7*

**7- Suppose that X and Y are jointly continuous random variables with joint p.d.f. as follows:**            $f(x,y)=24xy$   **for** $x, y>=0$ **and** $x+y=1$
                              $f(x,y)=0$        *otherwise*
**Find marginal distribution of f(x) and f(y) and conclude whether X, Y are independent or not.**

**8-If** $y=exp(-x)$ **and x is a random variable with the exponential p.d.f** $f(x)=exp(-x)$, **then find the probability density function (p.d.f) of random variable,** $f(y)$.

**9 – formulate predator-prey problem with x(t) and y(t) populations.**