

**Simulation**  
**3-rd and 4-th Year Undergraduate**  
**Mid-Term Examination**  
**2006-12-4 time: 90 minutes (score: each 10)**

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**Faculty of Engineering**  
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*1- In a post-office with single-server: a) What are events? B) What are state variables?*

*2- Define the Monte Carlo simulation.*

*3- In the pilot training system, what is iconic model?*

*4- What is simulation clock? Name two approaches for the simulation clock advancement.*

*6- In M/M/1 queue, what kind of random number's p.d.f do you advise for inter arriving and service times?*

*7- In which simulation model, a) time is considered? b) random numbers are used?*

8-Find the value of the following integral by using the Monte-Carlo method and compare with the true value of the integral (use  $n=13$  points as shown in the table).

$$I = \int_0^{2\pi} x \sin(x) dx$$

$i$	1	2	3	4	5	6	7	8	9	10	11	12	13
$x_i$	0	$\pi/6$	$2\pi/6$	$3\pi/6$	$4\pi/6$	$5\pi/6$	$6\pi/6$	$7\pi/6$	$8\pi/6$	$9\pi/6$	$10\pi/6$	$11\pi/6$	$12\pi/6$
$g(x_i)$	0	0.26	0.9	1.57	1.8	1.3	0	-1.8	-3.63	-4.7	-4.5	-2.88	0

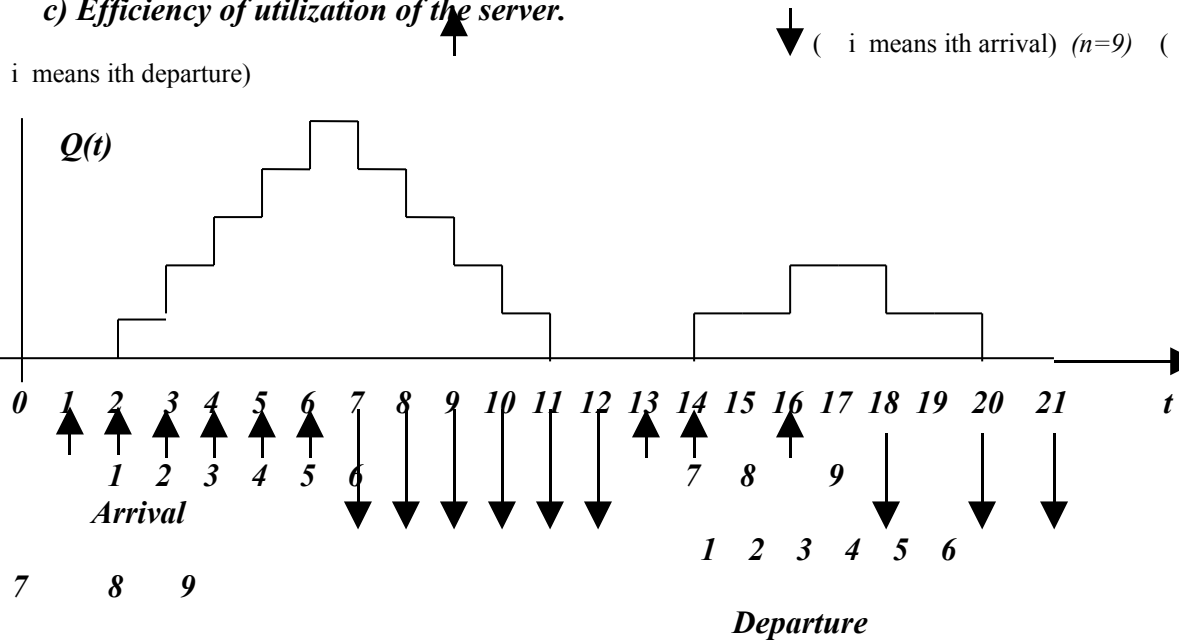
where:  $g(x_i) = x_i \sin(x_i)$

Using Integral:  $I =$

Using Monte-Carlo:  $I =$

9-In the following single server queuing M/M/1 system, find:

- Average delay in queue.
- Average number of customers in the queue.
- Efficiency of utilization of the server.



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