CMR
INSTITUTE OF TECHNOLOGY

Internal Assessment Test 1 – March. 2018-SCHEME OF EVALUATION

Sub:	System Modelling and Simulation							Code:	10CS82
Date:	12/ 03/2018	Duration:	90 mins	Max Marks:	50	Sem:	VIII	Branch:	CSE/ISE

Note: Answer any five questions:

1.	Explain the steps in simulation study with the help of a flowchart. - **For flowchart – 3 Marks** - **Explanation of all the 12 steps – 5 Marks** - **Defining Phases – 2 Marks**	3M 7M

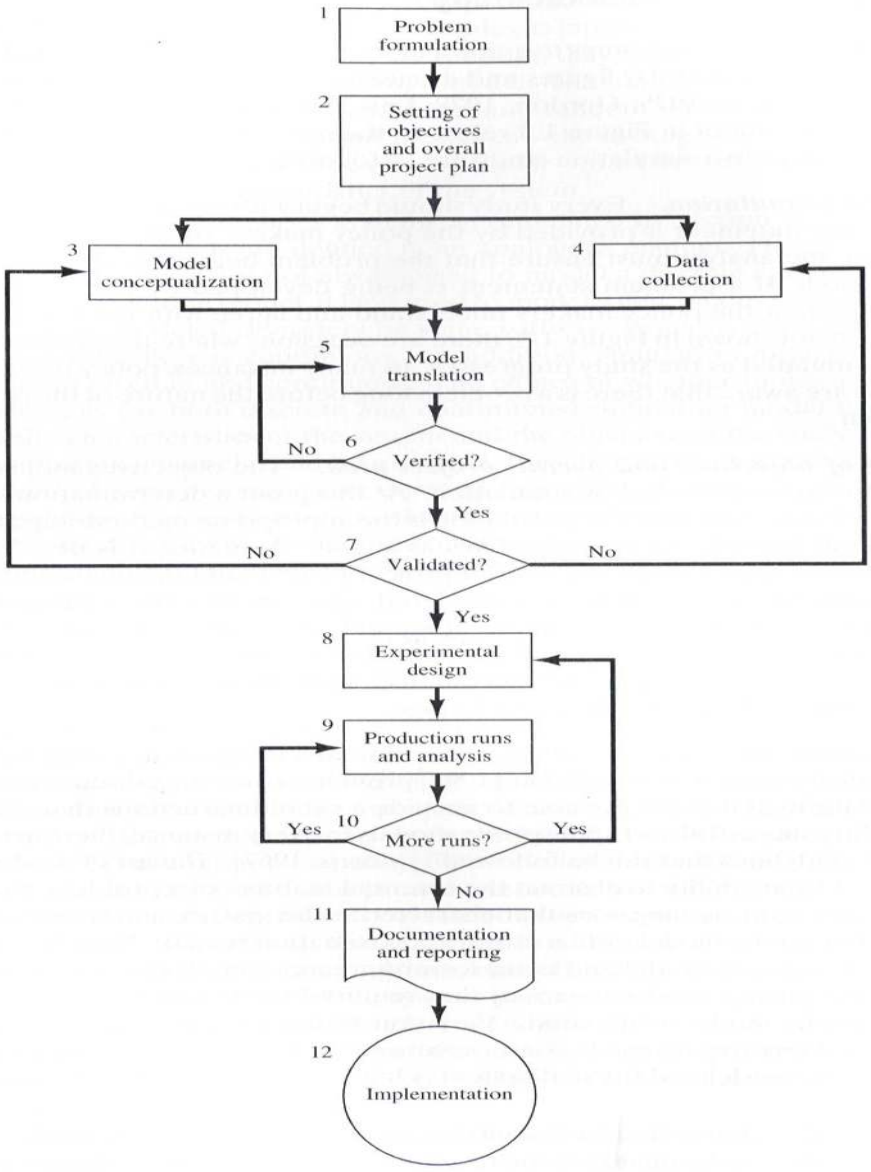

Figure 1.3. Steps in a simulation study.

- **Four phases according to Figure 1.3**

- **First phase : a period of discovery or orientation (step 1, step2)**
- **Second phase : a model building and data collection (step 3, step 4, step 5, step 6, step 7)**
- **Third phase : running the model (step 8, step 9, step 10)**
- **Fourth phase : an implementation (step 11, step 12)**

2. Let the arrival distribution be uniformly distributed between 1 to 10 min. Develop a simulation table for 5 customers. The service time distributions are as follows. 10M

Service Time	1	2	3	4	5
Probability	0.10	0.20	0.30	0.25	0.10

Consider the following random numbers for inter Arrival Times and Service Times.

Random No for IAT: 9, 7, 1, 9 ,3 ,2 ,4 , 6 ,1 ,4 Random No for Service Times: 84, 10, 74, 53, 17, 67, 49, 95, 28, 37. Find the average waiting time and probability of idle time of server from the simulation table.

-For finding the cumulative probability and random numbers for IAT-1M

IAT	Probability	Cumulative Probability	Random No Assessment
1	0.1	0.1	1
2	0.1	0.2	2
3	0.1	0.3	3
4	0.1	0.4	4
5	0.1	0.5	5
6	0.1	0.6	6
7	0.1	0.7	7
8	0.1	0.8	8
9	0.1	0.9	9
10	0.1	1.0	10

-For finding the cumulative probability and random numbers for service times-1M

ST	Probability	Cumulative Probability	Random No Assessment
1	0.10	0.10	1-10
2	0.20	0.30	11-30
3	0.30	0.60	31-60
4	0.25	0.85	61-85
5	0.10	0.95	86-100

-Main Simulation table-7Marks.

***The marks split up for this table is as shown below**

-For finding the Inter-arrival times and arrival times-1M

- For finding the service times from the random numbers-1M

-For finding the time service begins, time service ends, waiting time etc-5M.

Customer	IAT	AT	ST	Time Service Begins	Waiting Time	Time Service Ends	Time Customer Spend in system	Idle time of server
1	-	0	4	0	0	4	4	0
2	9	9	1	9	0	10	1	5
3	7	16	4	16	0	20	4	6
4	1	17	3	20	3	23	6	0
5	9	26	2	26	0	28	2	3
6	3	29	4	29	0	33	4	1
7	2	31	3	33	2	36	5	0
8	4	35	5	36	1	41	6	0
9	6	41	2	41	0	43	2	0
10	1	42	3	43	1	46	4	0
	Total		**31**		**7**			**15**

-For finding the average waiting time and Probability of idle time of server-1M

Average WT = Total WT/Total No of customers =7/10
Probability of idle time of server = Total idle time/Total run time of simulation = 15/46

3. 10M

A computer technical support is staffed by two people, Able and Baker who take calls and try to answer questions and solve computer problems. The time between the calls ranges from 1 to 4min with the distribution as shown in the table 1.1 below. Able is more experienced and can provide service faster than baker which means that, when both are idle able takes a call. The distribution of service times are shown in the table 1.2 below.

Time b/n arrivals	1	2	3	4
Probability	0.25	0.40	0.20	0.15

Table 1.1 : Inter arrival time(IAT) distribution

Service Time of Able	2	3	4	5
Probability	0.30	0.28	0.25	0.17

Service Time of Baker	3	4	5	6
Probability	0.35	0.25	0.20	0.20

Table 1.2 : Service time distribution of Able and Baker

Consider the following random numbers.
Random no for Arrivals: 26,98,90,26,42,74,80,68,22,48 &
Random no for Service Time: 95,21,51,92,89,38,13,61,50,49
Simulate this system for 10 callers by finding i) Average waiting time
ii) Average inter arrival time iii) Average Service Time of Able
iv) Average Service Time of Baker

-For Finding the cumulative probability and random numbers for inter-Arrival Times-1M

Inter-Arrival time	**Probability**	**Cumulative Probability**	**Random No Assessment**
1	**0.25**	**0.25**	**1-25**
2	**0.40**	**0.65**	**26-65**
3	**0.20**	**0.85**	**66-85**
4	**0.15**	**1.00**	**86-00**

-For Finding the Cumulative probability and random no for service times of Able and Baker-2M

ST of Able	Probability	Cumulative Probability	Random No Assessment	ST of Baker	Probability	Cumulative Probability	Random No Assessment
2	**0.30**	**0.30**	**1-30**	**3**	**0.35**	**0.35**	**1-35**
3	**0.28**	**0.58**	**31-58**	**4**	**0.25**	**0.60**	**36-60**
4	**0.25**	**0.87**	**59-87**	**5**	**0.20**	**0.80**	**61-80**
5	**0.17**	**1.00**	**88-00**	**6**	**0.20**	**1.00**	**81-100**

-Main Simulation Table-5M.

***The Marks Split up for this table is as shown below.**

-For Finding the Inter-Arrival Times from the random numbers-1M

-For Finding the arrival Times-1M

-For Finding the Service Times from the random numbers-1M

-For Finding the available server and time service begins-1M

-For Service completion time and time in the system-1M

Caller ID	IAT	AT	Server Choosen	ST	Time Service Begins	Time Service Ends		Caller Delay	Time Customer Spend in system
						Able	Baker		
1	-	0	Able	5	0	5	-	0	5
2	2	2	Baker	3	2	-	5	0	3
3	4	6	Able	3	6	9	-	0	3
4	4	10	Able	5	10	15	-	0	5
5	2	12	Baker	6	12	-	18	0	6
6	2	14	Able	3	15	18	-	1	4
7	3	17	Able	2	18	20	-	1	3
8	3	20	Able	4	20	24	-	0	4
9	3	23	Baker	4	23	-	27	0	4
10	1	24	Able	3	24	27	-	0	3
Total	24							2	

- **For finding the following times – 2 Marks**

Average WT = Total WT/Total No of customers =2/10 =0.20 Min
Average Interarrival Time = Total IAT/Total No of customers-1 =24/9 =2.66 Min
Average ST of Able = Total ST of Able/Total No of customers =25/10 =2.5 Min
Average ST of Baker = Total ST of Baker/Total No of customers =13/10 =1.3 Min

4. **a)** Explain time advance/event scheduling algorithm with the help of a snapshot. 5M

-Old system snapshot for time advance algorithm-1.5M

CIK	System State		Future Event List
T	(5,1,6)		(3, t1)— Type 3 event to occur at time *t1* (1, t2)— Type 1 event to occur at time *t2* (1, t3)- Type 1 event to occur at time t_3 (2, *tn*)— Type 2 event to occur at time t_n

-New System snapshot for time advance algorithm-1.5M

OCK	System State		Future Event List
t1	(5,1,5)		(1, *t2*)— Type 1 event to occur at time *t1* (4, t*)— Type 4 event to occur at time t* (1, t_3)— Type 1 event to occur at time t_3 (2, tn)— Type 2 event to occur at time *tn*

-Steps for time advance algorithm-2M

Step 1. Remove the event notice for the imminent event (event 3, time t\) from PEL
Step 2. Advance CLOCK to imminent event time (i.e., advance CLOCK from r to t1).
Step 3. Execute imminent event: update system state, change entity attributes, and set membership as needed.
Step 4. Generate future events (if necessary) and place their event notices on PEL ranked by event time. (Example: Event 4 to occur at time t*, where t2 < t* < t3.)
Step 5. Update cumulative statistics and counters.

5M

b) Explain about list Processing.

-Explanation of list Processing – 2 Marks

List Processing deals with the methods for handling lists of entities and the future event list

Basic Properties and Operations : Removing a record from the top of the list
Removing a record from any location
Adding a record to the top or bottom of the list
Adding a record at any arbitrary position

-Explanation about arrays and linked lists and activities-3 Marks

Example using arrays and linked lists for dump truck problem

5. Consider the following inter-arrival times and service times. Using time advance algorithm prepare a simulation table based on the following activities and stop the Simulation when clock reaches 20**.** 10M

Inter-arrival Time	3	2	6	2	4	5
Service Time	2	5	5	8	4	5

-For defining the system states like LQ(t),LS(t) – 2M

-For defining the Future Event List-4M

-For Updating the Cumulative statistics like B and MQ-2M

-For Simulation table defining all the above entities-2M

Clock	System State		Future Event List	Comments	Cumulative Statistics	
	LQ(t)	LS(t)			B	MQ
0	0	1	(D,2)(A,3)(E,20)	1st Customer arrived	0	0
2	0	0	(A,3)(E,20)	1st Customer departured	2	0
3	0	1	(A,5)(D,8)(E,20)	2nd Customer arrived	2	0
5	1	1	(D,8)(A,11)(E,20)	3rd Customer Arrived	4	1
8	0	1	(A,11)(D,13)(E,20)	2nd Customer Departured	7	1
11	1	1	(A,13)(D,13)(E,20)	4th Customer Arrived	10	1
13	1	1	(A,17)(D,21)(E,20)	5th Customer Arrived & 3rd Customer Departured	12	1
17	2	1	(A,21)(D,21)(E,20)	6th Customer Arrived	16	2
20	2	1	(A,21)(D,21)	End of simulation time	19	2

6 The activity times is given in the following table for Dump-Truck 10 M

Loading Time	10	5	5	10	15	10	10	15
Weighing Time	8	12	8	16	12	8		
Travel Time	30	60	80	40	50	70		

-For Simulation table for dump-truck problem-8M

***The Marks split up is as shown below**

-For defining the system states like LQ(t),L(t),WQ(t),W(t)-2M

- For defining the lists like loader queue and weighing queue-2M

-For Defining the Future event list-2M

-For updating the cumulative statistics and counters-2M

-For calculating the loader utilization and scale utilization-2M

Assume that 4 trucks are at loaders and 2 trucks are at weighing at time '0'. Ending time is completion of four weighing

clock	System state LQ(t)	LT(t)	WQ(t)	WT(t)	Loader queue	Weigh queue	FEL	BL	BS
0	1	2	2	1	1	D5, D6	D2	(D1, 8, EW) (D3, 5, EL) (D4, 10, EL)	0	0
5		1	2	2	1	D6	D2, D3	(D1, 8, EW) (D4, 10, EL) (D5, 5+5, EL)	10	5
8	1	1	2	1	1	D6	D3	(D4, 10, EL) (D5, 10, EL) (D2, 12+8, EW) (D1, 30+8, ET)	16	8
10		0	1	3	1	—	D3, D4, D5	(D6, 10+10, EL) (D2, 20, EW) (D1, 38, ET)	20	10
20		0	0	3	1	—	D4, D5, D6	(D1, 38, ET) (D2, 60+20, ET) (D3, 20+8, EW)	30	20

	28 | 0 0 2 1 | – | D5, D6 | (D1, 38, ET) (D2, 80, ET) (D3, 80+28, ET) (D4, 28+16, EW) | 30 | 28 38 | 0 0 2 1 | – | D5, D6 | (D4, 44, EW) (D1, 38+15, EL) (D2, 80, ET) (D3, 108, ET) | 30 | 38 44 | 0 1 1 1 | – | D6 | (D4, 40+44, ET) (D1, 53, EL) (D2, 80, ET) (D3, 108, ET) (D5, 44+12, [illegible]) | 36 | 44 Avg loader utilization = 36/2 / 44 Avg scale utilization = 44/44 = 1		
7.	a) What is Simulation. Explain different types of models used in simulation with examples. **-Definition of simulation – 1 Mark** Definition : Simulation is the imitation of the real world or system over time **- Defining and Explaining Models – 2 Marks** Three Types of Models: Static and Dynamic Models Deterministic and Stochastic Models Discrete And Continuous Models **- Examples of models – 2 Marks** b) Charlie tosses a coin for her friends Harry and Tom exactly 100 times. Harry wins $1.00 when a head lands up and Tom loses $1.00.Tom wins when the coin lands with tails up and Harry paying $1.Charlie tracks their respective wins and losses as they play the game. The probability for coin tosses are as follows. Coin Toss | Head | Tail Probability | 0.50 | 0.50 Simulate for 10 tosses by noting down the result of the toss each time. Consider the following random numbers. Random numbers: 30, 25, 60, 80, 90 **- For finding the cumulative probability and random numbers-1M**		5M 5M

Coin Toss	Probability	Cumulative Probability	Random No Assessment
Head	0.50	0.50	1-50
Tail	0.50	1.00	51-100

- Main Simulation Table-4M

***The Marks split up for the above table is as shown below.**

- **For finding the result of the toss from the random numbers-2M**
- **For finding Harry's Winnings-1M**
- **For finding Tom's Winnings-1M**

Coin Toss	Result Of the Toss	Harry's Winnings	Tom's Winnings
1	Head	$1	-$1
2	Head	$2	-$2
3	Tail	$1	-$1
4	Tail	0	0
5	Tail	-$1	$1