Uoll 7	Fieldst Number	20N	/IE604D
	III/IV B.Tech (Regular) DEGREE EXAMINATION		
July/A	August,2023 Mechanical	Engi	neering
Sixth	Semester Operatio	ons Re	esearch
Time: 7	Three Hours Max	imum:	70 Marks
Answei Answei	question 1 compulsory. $(14X1 =$ one question from each unit. $(4X14 =$	14Mar 56 Mar	ks) ks)
1 a)	Define Operations Research?	CO1	L1
	O.R. is the application of modern methods of mathematical science to complex problems involving management of large systems of men, machines, materials, and money in industry, business,		
1 \	government and defence	001	T 1
D)	Explain the Mathematical formulation of LPP problem? If x_i ($i = 1,2,3,,n$) are the n decision variables of the problem and if the system is subject to	COI	LI
	m constraints, the general mathematical model can be written in the form:		
	Optimize $Z = f(x_1, x_2, \dots, x_n)$		
	Subject to $g_i(x_1, x_2,, x_n) \le =, \ge b_i, (i = 1, 2,, m)$		
	(Called structural constraints)		
	And $x_1, x_2, \dots, x_n \ge 0$		
	(Called the non-negativity restrictions or constraints)		
c)	What are the characteristics of a good model?	CO1	L1
	 It should be reasonably simple. A good model should be capable of taking into account new changes in the situation affecting its frame significantly with ease i.e., updating the models should be as simple and 		
	easy as possible. 3. Assumptions made to simplify the model should be as small as possible.		
	 Number of variables used should be as small in number as possible. 		
	5. The model should be open to parametric treatment.		
d)	Define artificial variable	CO2	L1
	The procedure for starting "ill-behaved" LPs with (=) and (\geq) constraints is to use <i>artificial variables</i> that play the role of slacks at the first iteration, and then dispose of them legitimately at a later iteration. They merely used to get the starting basic feasible solution.		
e)	Explain degeneracy in transportation problems?	CO2	L1
	In a transportation problem, whenever the number of non-negative independent allocations is less than m+n-1, the transportation problem is said to be a degenerate one. Degeneracy may occur either at the initial stage or at an intermediate stage at some subsequent iteration.		
f)	Distinguish transportation model and assignment model The assignment problem is a particular case of transportation problem in which the number of jobs	CO2	L1
	(or origins or sources) are equal to the number of facilities (or destinations or machines or persons and so on). The objective is to maximize total profit of allocation or to minimize the total cost. An assignment problem is a completely degenerate form of a transportation problem. The units available at each origin and the units demanded at each destination are all equal to one.		
g)	What is the distribution for service time? Service time is the time required for completion of a service. i.e., it is the time interval between beginning of a service and its completion. The mean service rate ' μ ' is the number of customers served per unit time (Assuming the service to be continuous throughout the entire time unit). The average service time $1/\mu$ is the time required to serve one customer. The most common type of distribution used for service times is exponential distribution. It involves the probability of completion of a service. Mean service rate μ is assumed to be constant over time and independent of number of units already serviced, queue length or any other random property of the system.	CO3	L1
h)	Define Saddle point If the maximin and minimax values are equal then mark the position of that pay-off in the matrix. This element represents the value of the game and it is called the <i>saddle point</i> of the game.	CO3	L1
i)	State Bellman's Principle of optimality. It states, "An optimal policy (a sequence of decisions) has the property that whatever the initial state and decision are the remaining decisions must constitute an optimal policy with regard to the state	CO4	L1

and decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision". This principle implies that a wrong decision taken at one stage does not prevent from taking of optimum decisions for the remaining stages.

Explain about pay off matrix It is the outcome of the game. Pay off (gain or game) matrix is the table showing the amount received by the player named at the left-hand side after all possible plays of the game. The paymen is made by player named at the top of the table.						L1	
What is pure strates 1. <i>Pure strates</i> usually repr	gy and mixed strat gy: It is the decision esented by a number	egy ion rule to always select with which the course o	a particular course f action is associated	of action. It is d.	CO1	L1	
2. <i>Mixed strate</i> play in acco among pure	egy: It is decision, ir ordance with some pr strategies with some	n advance of all plays, to robability distribution. T e fixed probabilities (prop	choose a course of hus, a mixed strateg portions).	action for each gy is a selection			
Explain about KEN Kendall's notation	NDALL'S notation n is given by:				CO1	L1	
(a /b /c): (d/	e/f)						
Where a	= Arrivals distrib	ution					
b =	= Departures (ser	vice time) distributio	n				
<i>c</i> =	= Number of para	allel servers (=1, 2,	$(,\infty)$				
d	= Queue disciplir	ne					
<i>e</i> =	= Maximum num	ber (finite or infinite)) allowed in the	system			
	(in queue pl	us in-service)					
f	= Size of the calli	ing source (finite or i	nfinite)				
What is simulation Simulation is a num of mathematical and of a complex real w	? merical technique d logical relations vorld system over o	for conducting experin hips necessary to descr extended period of time	nents that involve ribe the behaviour e.	certain types and structure	CO1	L2	
Explain the advanta It is an appropriate (a) would be disru- events, and (d) doe It is a desirable too complex to solve, (enough to provide i	ages of simulation tool to use in solv ptive, (b) would s not permit contro l for solving a busi b) is beyond the ca information on all	? ing a problem when ex be too expensive, (c) ol over key variables. iness problem when a r apacity of available per important decision var	experimenting on the does not permit nathematical mod ronnel, and (c) is iables.	ne real system replication of el (a) is too not detailed	CO2	L2	
		<u>Unit-I</u>					
Solve the following	g LPP by Big M m N	ethod Iaximize $Z = 3X_1 - X_2$			CO1	L3	14M
Subjecte	ed to Constraints						
		$2X_1 + X_2 \ge 2$ $X_1 + 3X_2 \le 3$					
		$ \begin{array}{c} X_1 + 3X_2 \leq 3 \\ X_2 \leq 4 \\ X_1, X_2 \geq 0 \end{array} $					
	x1	x2					
Maximize Subject to	3.00	-1.00					
(1)	2.00	1.00	>=	2.00			
(2)	1.00	3.00	<=	3.00			
(3)	0.00	1.00	~-	4.00			
Lower Bound	d 0.00	0.00					
Unrestr'd (y/r	n)? n	n					
	Explain about pay It is the outcome of received by the player is made by player nation What is pure strate 1. Pure strate usually reproved 2. Mixed strate play in acco among pure Explain about KEN Kendall's notation (a / b / c) : (d/ Where $a :$ b : c : d : c : d : e : f : What is simulation Simulation is a numory of mathematical and of a complex real with Explain the advanta It is an appropriate (a) would be disru- events, and (d) doe It is a desirable too complex to solve, (enough to provide : Solve the following Subject of Unper Bound Unrestr'd (y/the) $Unrestr'd (y/the)$	Explain about pay off matrix It is the outcome of the game. Pay off received by the player named at the left- is made by player named at the top of the What is pure strategy and mixed stratt 1. Pure strategy: It is the decis usually represented by a number 2. Mixed strategy: It is decision, in play in accordance with some p among pure strategies with some Explain about KENDALL'S notation Kendall's notation is given by: (a / b / c) : (d / e / f) Where $a = \text{Arrivals distrib}$ b = Departures (ser c = Number of para d = Queue disciplin e = Maximum num (in queue pl f = Size of the callit What is simulation? Simulation is a numerical technique of mathematical and logical relations of a complex real world system over of Explain the advantages of simulation? It is an appropriate tool to use in solv (a) would be disruptive, (b) would events, and (d) does not permit control It is a desirable tool for solving a busic complex to solve, (b) is beyond the call solve the following LPP by Big M m Subjected to Constraints Maximize 3.00 Subject to (1) 2.00 (2) 1.00 (3) 0.00 Lower Bound 0.00 Upper Bound infinity Unrestr'd (y/n)? n	Explain about pay off matrix It is the outcome of the game. Pay off (gain or game) matrix received by the player named at the left-hand side after all possible is made by player named at the top of the table. What is pure strategy and mixed strategy 1. <i>Pure strategy</i> : It is the decision rule to always select usually represented by a number with which the course of 2. <i>Mixed strategy</i> : It is decision, in advance of all plays, to play in accordance with some probability distribution. The among pure strategies with some fixed probabilities (prop Explain about KENDALL'S notation. Kendall's notation is given by: ($a / b / c$): ($d / e / f$) Where $a = Arrivals distribution b = Departures (service time) distributionc = Number of parallel servers (=1, 2,, d = Queue disciplinee = Maximum number (finite or infinite)(in queue plus in-service)f = Size of the calling source (finite or i What is simulation? Simulation is a numerical technique for conducting experim of mathematical and logical relationships necessary to descr of a complex real world system over extended period of time Explain the advantages of simulation? It is an appropriate tool to use in solving a problem when ex (a) would be disruptive, (b) would be too expensive, (c) events, and (d) does not permit control over key variables. It is a desirable tool for solving a business problem when a recomplex to solve, (b) is beyond the capacity of available per enough to provide information on all important decision var Subjected to Constraints 2X_1 + X_2 \ge 2X_1 + X_2 \ge 2X_1 + X_2 \ge 2X_1 + X_2 \ge 0Maximize 3.00 -1.00(1) 2.00 1.00(2) 1.00 3.00(3) 0.00 1.00Lower Bound 0.00 0.00Upper Bound infinity infinityUnrestr'd (y/n)? n n n$	Explain about pay off matrix It is the outcome of the game. Pay off (gain or game) matrix is the table showin received by the player named at the teft-hand side after all possible plays of the game is made by player named at the top of the table. What is pure strategy and mixed strategy 1. Pure strategy: It is the decision rule to always select a particular course usually represented by a number with which the course of action is associate 2. Mixed strategy: It is decision, in advance of all plays, to choose a course of play in accordance with some probability distribution. Thus, a mixed strategy among pure strategies with some fixed probabilities (proportions). Explain about KENDALL'S notation. 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Pay off (gain or game) matrix is the table showing the anounts received by the player named at the telt-hand side after all possible plays of the game. The payment is made by player named at the top of the table. What is pure strategy and mixed strategy 1. <i>Pure strategy</i> : It is the decision rule to always select a particular course of action. It is usually prepresented by a number with which the course of action is associated. 2. <i>Mixed strategy</i> : It is decision, in advance of all plays, to choose a course of action for each play in accordance with some probabilities (proportions). Explain about KENDALL'S notation. Kendall's notation is given by: (a/b/c): (d/e/f) Where $a = Arrivals distribution$ b = Departures (service time) distribution $c = Number of parallel servers (=1, 2,, \infty)d = Queue disciplinee = Maximum number (finite or infinite) allowed in the system (in queue plus in-service) f = Size of the calling source (finite or infinite)What is simulation?Simulation is a numerical technique for conducting experiments that involve certain typesof anothematical and logical relationships necessary to describe the behaviour and structureof a complex real world system over extended period of time.Explain the advantages of simulation?It is an appropriate tool to use in solving a problem when experimenting on the real system(a) would be disruptive, (b) would be to expensive, (c) does not permit replication ofevents, and (d) does not permit corrol over key variables.It is a desirable tool for solving a business problem when a mathematical model (a) is toocomplex to solve, (b) is beyond the capacity of available personnel, and (c) is not detailedenough to provide information on all important decision variables.It is a desirable tool for solving a business problem when a mathematicalmodel (a) is too young be beyond the capacity of available personnel, and (c) is not detailedenough to provide infor$	Explain about pay off matrix CO4 It is the outcome of the game. Pay off (gain or game) matrix is the table showing the anomaly received by the player named at the left-hand side after all possible plays of the game. The payment is made by player named at the left of the table. What is pure strategy and mixed strategy 1. Pure strategy: It is the decision rule to always select a particular course of action. It is usually represented by a number with which the course of action is associated. 2. Mixed strategy: It is the decision rule to always select a particular course of action. It is usually represented by a number with which the course of action is associated. 3. Mixed strategy: It is the decision rule to always select a particular course of action. It is usually represented by a number with which the course of action is associated. 3. Mixed strategy: It is the decision rule to always select a particular course of action. It is usually represented by a number with which the course of action is associated. 3. Mixed strategy: It is decision, in advance of all plays, to choose a course of action for each play in accordance with some probability distribution Thus, a mixed strategy is a selection among pure strategies with some fixed probabilities (proportions). Explain about KENDALL'S notation. CO1 What is simulation? What is simulation? What is simulation? What is simulation? What is simulation? What is anumerical technique for conducting experiments that involve certain types of mathematical and logical relationships necessary to describe the behaviour and structure (a) would be disruptive, (b) would be too expensive, (c) does not permit replication of events, and (d) does not permit contor over key variables. This a appropriate tool to use in solving a problem when a mathematical model (a) is not complex tools, (b) is beyond the capacity of available personnel, and (c) is not detailed enough to provide information on all important decision variables. The desirable tool for solving	Explain about pay off matrix CO 1.1 It is the table showing the amounts received by the player named at the left-hand side after all possible plays of the game. The payment is made by player named at the top of the table. COI 1.1 It is the use and the top of the table. COI 1.1 It is usually represented by a number with which the course of action is associated. 2. <i>Mixed strategy</i> : It is decision, in dwaree of all plays, to choose a course of action in a selection and a number with which the course of action is associated. 2. <i>Mixed strategy</i> : It is decision repeating the strategy is a selection in a survey of the play in accordance with some probabilities (proportions). COI 1.1 Kendall's notation is given by: (a / b / c): (d / e / f) Where a = Arrivals distribution b = Departures (service time) distribution $c = $ Number of parallel servers $(=1, 2,, \alpha)$ $d = $ Queue discipline $e =$ Maximum number (finite or infinite) allowed in the system (in queue plus in-service) $f =$ Size of the calling source (finite or infinite) Simulation? Simulation? Simulation is a numerizal technique for conducting experiments that involve certain types of mathematical and logical relationships necessary to describe the behaviour and structure of a complex real world system over extended period of time. Explain the advantages of simulation? Simulation? Simulation? Simulation? Subjected to for solving a business problem when experimenting on the real system (a variables arrow yavaibles. Subject to for solving a business problem when experimenting on the real system (a secarable tool for solving a business problem when a particular condition of events, and (d) does not permit corrol over thy variables. Subject to Constraints $\frac{X_1 + X_2}{X_1 + 3X_2 \leq 3}$ $\frac{X_1 + X_2}{X_2 + 3X_1 + 3X_2}$ $\frac{X_1 + X_2}{X_1 + 3X_2 \leq 3}$ $\frac{X_2 \leq 4}{X_1 + X_2 \geq 3}$ $\frac{X_1 + X_2}{X_1 + 3X_2 \leq 3}$ $\frac{X_1 + X_2}{X_2 \leq 3}$ $\frac{X_1 + X_2}{X_1 + 3X_2 \leq 3}$ $X_1 $

Iteration 1 Basic z (max) Rx4 sx5 sx6 Lower Bound Upper Bound Unrestr'd (y/n)?	x1 -203.00 2.00 1.00 0.00 0.00 infinity n	x2 -99.00 1.00 3.00 1.00 0.00 infinity n	Sx3 100.00 -1.00 0.00 0.00	Rx4 0.00 1.00 0.00 0.00	sx5 0.00 0.00 1.00 0.00	sx6 0.00 0.00 0.00 1.00
Basic z (max) Rx4 sx5 sx6	Solution -200.00 2.00 3.00 4.00					
Iteration 2 Basic z (max) x1 sx5 sx6 Lower Bound Upper Bound Unrestr'd (y/n)?	x1 0.00 1.00 0.00 0.00 infinity n	x2 2.50 0.50 2.50 1.00 0.00 infinity n	Sx3 -1.50 -0.50 0.50 0.00	Rx4 101.50 0.50 -0.50 0.00	sx5 0.00 0.00 1.00 0.00	sx6 0.00 0.00 0.00 1.00
Basic z (max) x1 sx5 sx6	Solution 3.00 1.00 2.00 4.00					
Iteration 3 Basic z (max) x1 Sx3 sx6 Lower Bound Upper Bound Unrestr'd (y/n)?	x1 0.00 1.00 0.00 0.00 0.00 infinity n	x2 10.00 3.00 5.00 1.00 0.00 infinity n	Sx3 0.00 0.00 1.00 0.00	Rx4 100.00 0.00 -1.00 0.00	sx5 3.00 1.00 2.00 0.00	sx6 0.00 0.00 0.00 1.00
Basic z (max) x1 Sx3 sx6	Solution 9.00 3.00 4.00 4.00	A M	ns: fax Z= 9; x1=	=3, x2=0		

(OR)

Solve the following Linear Programming Problem by graphical method.CO1L314MMaximize Z=3X1+ 5X2Subject to the conditionsX1 ≤ 4 2X2 ≤ 12 $3X1 + 2X2 \leq 18$ andX1, $X2 \geq 0$ Subject to the conditions

Answer:

Summary of Optimal Solution: Objective Value = 36.00 x1 = 2.00 x2 = 6.00



<u>Unit-II</u>

CO2 L4 14M

	D_1	D ₂	D ₃	D_4	Supply
\mathbf{S}_1	5	2	4	3	22
S_2	4	8	1	6	15
S ₃	4	6	7	5	8
Demand	7	12	17	9	

Iteration 1:

5

4

ObjVal 104.00

Find the optimum transportation Cost

			D1	D2	D3	D4	Supply
	Name		v1=2.00	v2=2.00	v3=4.00	v4=3.00	
S1		u1=0.00	5.00 -3.00	2.00 12 0.00	4.00 2 0.00	3.00 8 0.00	22
S2		u2=-3.00	4.00 -5.00	8.00	1.00 15 0.00	6.00 -6.00	15
S3		u3=2.00	4.00 7 0.00	6.00	7.00	5.00 1 0.00	
	Demand		7	12	17	9	

(**OR**)

A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix.14

				Employees		
		Ι	II	III	IV	V
	A	10	5	13	15	16
	B	3	9	18	13	6
Jobs	С	10	7	2	2	2
	D	7	11	9	7	12
	Ε	7	9	10	4	12

CO2 L4 14M

Marks

How should the jobs be allocated, one per employee, so as to minimize the total manhours?



<u>Unit-III</u>

Solve the game whose payoff matrix is given below:

		Playe	r B	
Player A	<i>B</i> ₁	B_2	<i>B</i> ₃	B_4
A_1	3	2	4	0
A_2	3	4	2	4
$\overline{A_3}$	4	2	4	0
A_4	0	4	0	8

The given pay-off matrix is:

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	B_1	B_2	B ₃	B_4	Row minimum
A_1	3	2	4	0	0
A_2	3	4	2	4	2
A_3	4	2	4	0	0
A_4	0	4	0	8	0
Column maximum	4	4	4	8	

There is no saddle point. Row 3 dominates over row 1 hence row 1 can be deleted. Thus we get;

	\mathbf{B}_1	B_2	\mathbf{B}_3	B_4
A_2	3	4	2	4
A ₃	4	2	4	0
A_4	0	4	0	8

CO3 L4 14M

Here we find that column 1 is dominated by column 3 and therefore we can delete column 1. The resulting matrix is given by;

	B_2	B_3	\mathbf{B}_4
A_2	4	2	4
A_3	2	4	0
A_4	4	0	8

We find that column 1 (B_2) is inferior to a convex combination of columns 2 (B_3) and columns 3 (B_4).

$$4 \ge \frac{(2+4)}{2}, 2 \ge \frac{4+0}{2}, 4 \ge \frac{0+8}{2}, \qquad (\lambda_1 = \lambda_2 = \frac{1}{2})$$

 \therefore column 1 can be deleted and the resulting matrix is:



Again in this matrix, row 1 is dominated by a convex combination of rows 2 and 3.

 $2 \le \frac{(4+0)}{2}, 4 \le \frac{0+8}{2}, \ (\lambda_1 = \lambda_2 = \frac{1}{2})$ and hence row 1 can be deleted. Finally we get;

. .

$$p_{3} = \frac{(a_{22} - a_{21})}{(a_{11} + a_{22}) - (a_{12} + a_{21})} = \frac{8 - 0}{12} = \frac{2}{3}$$

$$p_{4} = 1 - p_{3} = 1 - \frac{2}{3} = \frac{1}{3}$$

$$q_{3} = \frac{(a_{22} - a_{12})}{(a_{11} + a_{22}) - (a_{12} + a_{21})} = \frac{(8 - 0)}{12} = \frac{2}{3}$$

$$q_{4} = 1 - q_{3} = 1 - \frac{2}{3} = \frac{1}{3}$$

Value of the game is

$$v = \frac{32}{12} = 8/3$$

The optimal strategies are;

$$S_A = \begin{pmatrix} A_1 & A_2 & A_3 & A_4 \\ 0 & 0 & 2/3 & 1/3 \end{pmatrix} \quad and \quad S_B = \begin{pmatrix} B_1 & B_2 & B_3 & B_4 \\ 0 & 0 & 2/3 & 1/3 \end{pmatrix}$$

(**OR**)

A television repairman finds that the time spent on his jobs has an exponential distribution CO3 L3 14M with a mean of 30 minutes. If he repairs the sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hour day, what is the repairman's expected idle time each day? How many jobs are ahead of the average set just brought in?

Arrival rate $\lambda = \frac{10}{8 \times 60} = \frac{1}{48}$ units /minute

Service rate $\mu = \frac{1}{30}$ units/minute

Number of jobs ahead of the set brought in = average number of jobs in the system

$$L_{s} = \frac{\lambda}{\mu - \lambda} = \frac{1/48}{1/30 - 1/48} = 1.67 \text{ units}$$

Number of hours for which the repairman remains busy in an 8-hour day

$$= 8\frac{\lambda}{\mu} = 8 \times \frac{1/48}{1/30} = 8 \times \frac{20}{32} = 5 \text{ hours.}$$

Therefore, Time for which repairman remains idle in an 8-hour day= 8-5 = 3 hours.

<u>Unit-IV</u>

Solve using dynamic programming

Maximize $Z = 3x_1 + 4x_2$ subject to the constraints $2x_1 + 5x_2 \le 120$ $2x_1 + x_2 \le 40$ and $x_1, x_2 \ge 0$

Here we have two stages for two variables.

Stage 1

$$f_1(B_{11} B_{21}) = Max (c_1 x_1)$$
$$= Max(3x_1) = 3 Max(x_1)$$

$$= Max(3x_1) = 3 Max(x_1)$$

From the constraints we find that

$$x_1 \le \frac{120 - 5x_2}{2}$$
 and
 $x_1 \le \frac{40 - x_2}{2}$

In order to satisfy both the constraints

$$x_{1} \leq \min\left\{\frac{120 - 5x_{2}}{2}, \quad (40 - x_{2})/2\right\}$$

$$\therefore f_{1}(B_{11} B_{21}) = 3\min\left\{\frac{120 - 5x_{2}}{2}, \quad (40 - x_{2})/2\right\}$$

Stage 2

$$\begin{aligned} &f_2(B_{12} \ B_{22}) = Max \left\{ f_1(B_{11} \ B_{21}) + 4x_2 \right\} \\ &= Max \left[3 \min \left\{ \frac{120 - 5x_2}{2}, \frac{(40 - x_2)}{2} \right\} + 4x_2 \right] \\ &= max \left\{ \frac{3(120 - 5x_2)}{2} + 4x_2 \ if \ \frac{120 - 5x_2}{2} \le (40 - x_2)/2 \\ \frac{3(40 - x_2)}{2} + 4x_2 \ if \ \frac{120 - 5x_2}{2} \ge (40 - x_2)/2 \\ &\text{Now } \frac{120 - 5x_2}{2} \le \frac{40 - x_2}{2} \\ &\Rightarrow 120 - 5x_2 \le 40 - x_2 \\ &\Rightarrow 80 \le 4x_2 \Rightarrow x_2 \ge 20 \\ \frac{120 - 5x_2}{2} \ge \frac{40 - x_2}{2} \\ &120 - 5x_2 \ge 40 - x_2 \\ &\Rightarrow x_2 \le 20 \\ &\text{When } x_2 = 20 \\ \frac{3(120 - 5x_2)}{2} + 4x_2 = \frac{3(40 - x_2)}{2} + 4x_2 = 110 \\ &\therefore f_2(120, 40) = 110 \\ &x_2^* = 20 \ and \ x_1^* = (40 - x_2^*)/2 = 10 \\ &\text{Solution is } x_1 = 10, x_2 = 20 \ and \ Z^* = 10 \end{aligned}$$

110

CO4 L3

14M

(OR)

Simulation is a numerical technique for conducting experiments that involve certain types of mathematical and logical relationships necessary to describe the behaviour and structure of a complex real world system over extended period of time.

Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behaviour (within the limits imposed by a criterion or set of criteria) for the operation of the system.

Applications:

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It is used in a variety of problems such as Investment analysis, queuing models, Inventory models, LPPs

Advantages:

It provides trial-and-error movement towards the optimal solution.

The decision maker selects an alternative, experiences the effect of the selection, and then improves the selection. In this way, the selection is adjusted until it approximates the optimal solution.

Disadvantages:

(i) It may be the only method available, because it is difficult to observe the actual reality.

(ii) Without appropriate assumption, it is impossible to develop a mathematical solution.

(iii)There may not be sufficient time to allow the system to operate for a very long time.