Duration: 03 Hours   Total Marks: 80

Note:-
1. Question Number **ONE** is compulsory.
2. Attempt any **THREE** questions from remaining **FIVE** questions.
3. Assume suitable data if necessary.

Q1	Attempt **any four** question from the following:	20
a	Discuss applications of LP to managerial decision making	5
b	Generate a sequence of five two digit random numbers using mixed congruence generator with a = 21, b = 53, seed = 46 and m = 100	5
c	Explain dynamic programming and state its applications	5
d	Differentiate between assignment and transportation model	5
e	Explain various types of float in project scheduling.	5
f	Write a short note on duality theory	5

Q2 a Solve the LP problem by using Simplex method   **10**

Max: $Z = 5x + 3y$
S.T., $x + y \leq 2$
$5x + 2y \leq 10$
$3x + 8y \leq 12$
$x, y \geq 0$

b Find solution using dual simplex method.   **10**

Maximize $Z = -15x - 10y$
S.T., $-3x - 5y \leq -5$
$-5x - 2y \leq -3$
and $x,y \geq 0$

Q3 a A computer has a large number of electronics tubes. They are subject to the following   **10**
mortality rates:

t	0	1	2	3	4	5
P(t)	0	0.10	0.26	0.35	0.22	0.07

If the tubes are group replaced, the cost of replacement is Rs 15 per tube. Group
replacement can be done at fixed intervals in the night shift when the computer is
normally not used. Replacement of individual tube that fail in service, costs Rs 60
per tube. How frequently should the tubes be replaced?

b A company has factories at F1, F2 and F3 which supply to warehouses at W1, W2   **10**
and W3. Weekly factory capacities are 200, 160 and 90 units, respectively. Weekly
warehouse requirement are 180, 120 and 150 units, respectively. Unit shipping costs
(in rupess) are as follows:

	W_1	W_2	W_3	Supply
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	

Determine the optimal distribution for this company to minimize total shipping cost.

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Q4 a In a service department manned by one server, on an average 8 customers arrive every **8** 5 minutes while the server can serve 10 customers in the same time assuming Poisson distribution for arrival and exponential distribution for service rate. Determine:
  i) Average number of customers in the system.
  ii) Average number of customers in the queue.
  iii) Average time a customer spends in the system.
  iv) Average time a customer waits before being served.

b An established company has decided to add a new product to its line. It will buy the **12** product from a manufacturing concern, package it, and sell it to a number of distributors that have been selected on a geographical basis. Market research has already indicated the volume expected and the size of sales force required. The steps shown in the following table are to be planned.

Activity	Description	Predecessor Activity	Duration (days)
A	Organize sales office	-	6
B	Hire salesman	A	4
C	Train salesman	B	7
D	Select advertising agency	A	2
E	Plan advertising campaign	D	4
F	Conduct advertising campaign	E	10
G	Design package	-	2
H	Setup packaging campaign	G	10
I	Package initial stocks	J,H	6
J	Order stock from manufacturer	-	13
K	Select distributors	A	9
L	Sell to distributors	C,K	3
M	Ship stocks to distributors	I,L	5

(a) Draw an arrow diagram for the project.
(b) Indicate the critical path.
(c) For each non-critical activity, find the total and free float.

Q5 a A dentist schedules all his patients for 30 minute appointments. Some of the patients **10** take more or less than 30 minutes depending on the type of dental work to be done. The following table shows the summary of the various categories of work, their probabilities and the time actually needed to complete the work.

Category	Time Required (min)	Probability of Category
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Check-up	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic exactly at their scheduled arrival time, starting at 8.00 am. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17, 79

b A travelling salesman plans to visit five cities 1, 2, 3, 4 and 5. The travel time (in hours) between these cities is shown below.   **10**
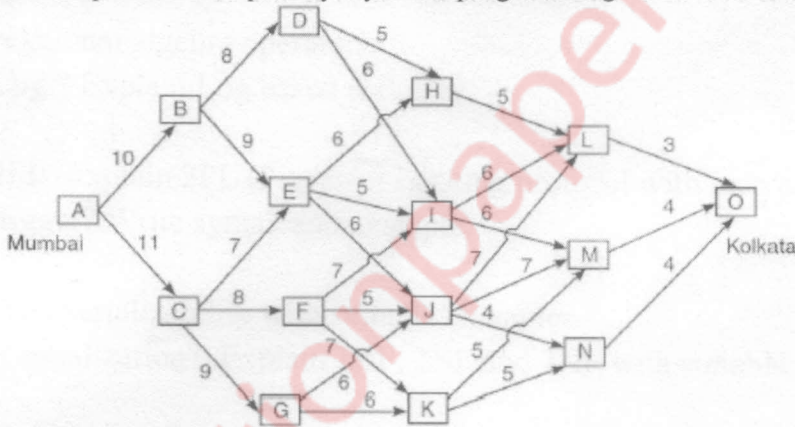
			To city			
		1	2	3	4	5
From city	1	x	5	8	4	5
	2	5	x	7	4	5
	3	8	7	x	8	6
	4	4	4	8	x	8
	5	5	5	6	8	x

How should he schedule his touring plan in order to minimize the total travel time, if he visits each city once a week?

Q6 a Find solution of game theory problem using dominance method   **10**

Player A \ Player B	B1	B2	B3	B4
A1	3	5	4	2
A2	5	6	2	4
A3	2	1	4	0
A4	3	3	5	2

b Determine the optimum tour plan by Dynamic programming.   **10**

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