11. a) A company has a demand of 12,000 unit/year for a item and can produce 2,000 such items per month. Th cost of one set-up is Rs. 400 and the holdin cost/unit/month is Re. 0·15. Find the optimum lot siz and the total cost per year, assuming the cost of on unit as Rs. 4. Also find the maximum inventor manufacturing time and total time. 2 + 1 + 2 +

b) The time estimates in hours for the activities of a PER network are given below :

Activity ($i - j$)	1 – 2	1 – 3	1 – 4	2 – 5	3 – 5	4 – 6	5 – 6
Optimistic time (t_o)	1	1	2	1	2	2	3
Most likely time (t_m)	1	4	2	1	5	5	6
Pessimistic time (t_p)	7	7	8	1	14	8	15

(i) Draw the project network.

(ii) Identify all paths through it and write critica path.

(iii) What should be scheduled completion time fo which the probability of completion is 90% confidence ? [Given $P (Z \leq 1{\cdot}28) = 0{\cdot}9$]

4 + 1 +

2013
OPERATIONS RESEARCH

ed : 3 Hours *Full Marks : 70*

The figures in the margin indicate full marks.

are required to give their answers in their own words as far as practicable.

sheet, if required, will be supplied by the institution.

GROUP – A

(Multiple Choice Type Questions)

the correct alternatives for any *ten* of the following : 10 × 1 = 10

PERT, the expected time (t_e) of each activity is

a) $\frac{4t_m - t_0 + t_p}{6}$ b) $\frac{t_p - 4t_m + t_0}{6}$

c) $\frac{t_0 - 4t_m + t_p}{6}$ d) none of these.

here t_0 =Optimistic time, t_p = Pessimistic time, t_m =Most likely time

The shortest route between any two nodes in a Network is determined by the following

a) Dijkastra's algorithm

b) Floyd's algorithm

c) Critical path method

d) none of these.

[Turn over

iii) The queue length is given by

a) $\frac{\rho^2}{1-\rho}$ b) $\frac{\rho}{1-\rho}$

c) $\frac{\rho^3}{1-\rho}$ d) none of these.

iv) Traffic intensity ρ is given by

a) λ / μ b) μ / λ

c) $\lambda\mu$ d) none of these.

v) A set of values of decision variables $x_1, x_2 \ldots\ldots x_n$ which satisfies the set of constraints and the non-negativity restrictions is called

a) an optimal solution

b) a feasible solution

c) only optimal solution

d) None of these.

vi) For maximization LP model, the simplex method is terminated when all value of $z_j - c_j$

a) ≥ 0 b) < 0

c) $= 0$ d) ≤ 0.

vii) In Simplex method, there will be multiple solutions if all $z_j - c_j \geq 0$ with some $z_j - c_j = 0$ corresponding to

a) all vectors

b) only basis vectors

c) basis vectors and non-basis vectors

d) none of these.

...em of m simultaneous linear equations in **... variables** ($m < n$), the number of basic **...ll be**

b) n

...n – m d) $m - n$.

...t is the method used to solve an LPP involving **...cial variables** ?

Simplex method

Charnes' Big-M method

VAM

...one of these.

...e dual has an unbounded solution, then primal has

...an unbounded solution

...an infeasible solution

...a feasible solution

...none of these.

...e solution of a transportation problem with m-source **...d n-destination** is feasible if the number of allocations

... $m + n - 1$ b) $m + n + 1$

... $m + n$ d) mn.

...wo-person zero-sum game is said to be fair if

both the players have equal number of strategies

the game has a saddle point

the game does not have a saddle point

the value of the game is zero.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Solve the LPP by graphical method :

Maximize $Z = 5x_1 + 7x_2$

subject to $x_1 + x_2 \le 4$

$3x_1 + 8x_2 \le 24$

$10x_1 + 7x_2 \le 35$; $x_1, x_2 \ge 0$.

3. Assuming for a period of 2 hours in a day (8A.M. – 10 A.M.), trains arrive at the yard every 20 minutes; the service time is 36 minutes per train, then calculate mentioning the queuing model :

(i) The probability that the yard is empty

(ii) Average number of trains in the queue assuming that the capacity of the yard is 4 trains only. 2 + 3

4. Define convex set. Show that the set $S = \{ (x_1, x_2) : x_1^2 + x_2^2 \le 4 \}$ is a convex set.

value λ, the game with the following pay-off matrix determinable ?

Player *B*

Player *A*		B_1	B_2	B_3
	A_1	λ	6	2
	A_2	–1	λ	0
	A_3	– 2	4	λ

Find the dual of the following LPP :

Maximize $Z = x_1 - x_2 + 3x_3 + 2x_4$

subject to $x_1 + x_2 \ge -1$

$x_1 - 3x_2 - x_3 \le 7$

$x_1 + x_3 - 3x_4 = -2$; $x_1, x_4 \ge 0$ and x_2, x_3 are unrestricted in sign.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

Solve the following LPP by simplex method :

Minimize $Z = -2x_2 - x_3$

subject to $x_1 + x_2 - 2x_3 \le 7$

$-3x_1 + x_2 + 2x_3 \le 3$; $x_1, x_2, x_3 \ge 0$. 6

Solve the following LPP by Charnes' Big-M method :

Maximize $Z = 3x_1 + 2x_2$

subject to $x_1 + x_2 \ge 1$

$2x_1 + x_2 \le 4$

$5x_1 + 8x_2 \le 15$; $x_1, x_2, x_3 \ge 0$. 9

8. a) Determine the optimal solution to the transportation problem and find the minimum total cost of transportation. 8

Destination

Source	D_1	D_2	D_3	D_4	a_i
A_1	19	30	50	10	7
A_2	70	30	40	60	9
A_3	40	8	70	20	18
b_j	5	8	7	14	

b) Solve the following assignment problem for minimum cost. 7

Men

Machine	A	B	C	D
M_1	18	26	17	11
M_2	13	28	14	26
M_3	38	19	18	15
M_4	19	26	24	10

9. a) Solve the following 2 × 2 game graphically. 7

Player B

Player A	B_1	B_2	B_3	B_4
A_1	2	1	0	- 2
A_2	1	0	3	2

dominance rule to reduce the payoff matrix and **the game** with the following payoff matrix : 8

Player B

Player A	B_1	B_2	B_3
A_1	4	7	1
A_2	3	6	- 4
A_3	- 2	-1	2

a) **A firm** manufactures two types of screws *A* and *B*. Type ***A*** screws earn a profit of Rs. 3.00 per thousand and **type** *B* Rs. 1·50 per thousand. Type *A* screws require a **special** chemical treatment. If all available facilities in **the** firm are utilised, 40,000 of type *A* screws can be **produced** per day against 60,000 of type *B* per day. The **chemicals** required for A are restricted in supply and are **sufficient** for a maximum of 30,000 screws per day. The **total** packing capacity of the firm is restricted to 50,000 **screws** per day. How many of types *A* and *B* in **thousands** should the firm manufacture to get **maximum** profit and what is the maximum profit ? The **firm works** 8 hours per day. 5 + 3

b) **Using Dijkastra's** algorithm, find the shortest distance **and shortest** path node *s* to node *t*. 5 + 2