This question paper contains 4 printed pages.

1806

Your Roll No.....

A

B.Sc. (H) / Computer Science / VI Sem.

Paper - 604

OPERATIONAL RESEARCH

(Admissions of 2001 and onwards)

Time : 3hours *Maximum Marks : 75*

(Write your Roll No. on the top immediately on receipt of this question paper.)

*Attempt **all** questions.*
Use of calculator is permitted.
Marks are indicated against each question.

1. (a) Discuss the scope of Operations Research in real world decision making problems. **(3)**

   (b) Wild West produces two types of cowboy hats. A type 1 hat requires twice as much labor time as a type 2. If all available labor time is dedicated to type 2 alone, the company can produce a total of 400 type 2 hats a day. The respective market limits for two types are 150 and 200 hats per day. The profit is ₹8 per type 1 hat and ₹5 per type 2 hat.
   Formulate a linear programming model and solve graphically to find the number of hats of each type that would maximize profit. **(6)**

2. Solve the following Linear Programming Problem (LPP) :

$$\begin{aligned} &Min Z = 2x_1 + 3x_2 - 5x_3 \\ &\textit{subject to} \\ &x_1 + x_2 + x_3 = 7 \\ &x_1 - x_2 + x_3 \geq 10 \\ &x_1, x_2, x_3 \geq 0 \end{aligned}$$ **(8)**

3. .Consider the following (LPP) :

$$\begin{aligned} &\textit{Minimize } z = 4x_1 + x_2 \\ &s.t. 3x_1 + x_2 = 3;\ 4x_1 + 3x_2 \geq 6;\ x_1 + 2x_2 \leq 4;\ x_1, x_2 \geq 0 \end{aligned}$$

If x_4, x_5 are the artificial variables and x_6 is a slack variable, by considering M=100 for artificial variables, the optimal table for primal problem is

Basic	X1	X2	X3	X4	X5	X6	Solution
Z	0	0	0	-98.6	-100	-.2	3.4
X1	1	0	0	.4	0	-.2	.4
X2	0	1	0	.2	0	.6	1.8
X3	0	0	1	1	-1	1	1.0

(i) Write the associated dual problem.

(ii) Determine the optimal solution of the dual. (8)

4. (a) Write the following Transportation Problem as a LPP. (7)

Destination / Source	D1	D2	D3	D4	Availability
S1	10	15	12	12	200
S2	8	10	11	9	150
S3	11	12	13	10	120
Demand	140	120	80	220	

Find the optimal shipping schedule using transportation methods.

(b) A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking into account the capabilities of sales man and the nature of districts, the company estimates that the profit per day in rupees for each salesman in each district is as below: (7)

	1	2	3	4
A	42	35	28	21
B	30	25	20	15
C	30	25	20	15
D	24	20	16	12

Find the optimal assignment of salesman to various districts.

5. A vessel is to be loaded with stocks of three items. Each unit of item i has a weight w_i and the value r_i. The maximum cargo weight the vessel can take is 4 tonnes and the details of the three items are as follows:

I=Items	w_i (tons)	r_i
1	2	31
2	3	47
3	1	14

(a) Write the mathematical model of the knapsack problem to determine the most valuable cargo without exceeding the maximum cargo weight for the above data. **(3)**

(b) Use dynamic programming technique to solve the mathematical model. **(7)**

6. (a) Solve the 5X2 game for the player B whose payoff matrix is as follows: (6)

Player B

B1 B2

$$\text{Player A} \begin{pmatrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{pmatrix}$$

(b). Consider the following quadratic programming problem: **(5)**

$$Min\, Z = 6 - 6x_1 + 2x_1^2 - 2x_1x_2 + 2x_2^2$$
$$s.t.\ x_1 + x_2 \le 2$$
$$x_1, x_2 \ge 0$$

Write the KKT conditions and formulate the linear programming problem to find the optimal solution using Wolfe's method.

7(a). For the queuing model M/M/I with unlimited capacity, set up the transition diagram, and then write and solve the steady state equation to determine P_n, the probability that the system has n customers at any arbitrary point of time. **(3)**

(b) A self service store employs a cashier at its counter. An average of 9 customers arrive every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find and interpret. **(4)**

i) Average number of customers in the system.

ii). Average number of customers in queue.

iii). Average time a customer spends in the system.

iv). Average time a customer waits before being served.

8. Three time estimates (in months) of all the activities of a project are as given below:

Activity:	1-2	2-3	2-4	3-4	4-5	5-6	
a	:0.8	3.7	6.2	2.1	0.8	0.9	(optimistic time)
m	:1.0	5.6	6.6	2.7	3.4	3.4	(most likely time)
b	:1.2	9.9	15.4	6.1	3.6	2.7	(pessimistic time) **(8)**

(a) Construct the project network.

(b) Determine the critical path, expected project length and expected variance of project length.

(c) What is the probability that the project will be completed one month earlier than expected project length?

(d) Which due date for project completion has about 95% chance of being met?

Given $\phi(0.81) = 0.7910$ and Z value for 95% area=1.65 (approx.)