**Answer All Five Questions**                                    **Time: 03 Hours**

Q1. (a)   Solve the following minimization problem:

Find the minimum value of

$Z = 2x_1 + 10x_2 + 8x_3$, subject to the constraints:

$$
\begin{aligned}
x_1 + x_2 + x_3 &\geq 6 \\
x_2 + 2x_3 &\geq 8 \\
-x_1 + 2x_2 + 2x_3 &\geq 4
\end{aligned}
$$

where $x_1 \geq 0$, $x_2 \geq 0$, and $x_3 \geq 0$

(12 Marks)

(b)   The following payoff table shows two state of natures and three decision alternatives. The profit that will result from each decision alternative will be determined by whether good or poor foreign competitive condition exist.

| Decision | State of Nature | |
|---|---|---|
| | Good foreign competitive condition | Poor foreign competitive condition |
| Expand | Rs. 800,000 | Rs. 500,000 |
| Maintain status quo | Rs. 1,300,000 | Rs. - 150,000 |
| Sell now | Rs. 320,000 | Rs. 320,000 |

(i) *Determine* the best decision by using the following decision criteria:

1.  Maximax
2.  Maximin
3.  Minimax regret
4.  Hurwicz ($\alpha = 0.3$)
5.  Equal likelihood

(05 Marks)

**(ii)** Assume that it is now possible to estimate a probability of 0.7 that go
competitive conditions will exist and a probability of 0.3 that poor cond
exist. **Determine** the best decision by using expected value and
opportunity loss.

(

(Total

**Q2. (a)** Given the stock available at the warehouse (A, B, C), and the requireme
dealers (W, X, Y, Z), and the distances shown (Use Rs.1/= per km transp
determine the optional set of transportation to fill all demands. What is th
the minimum transportation cost?
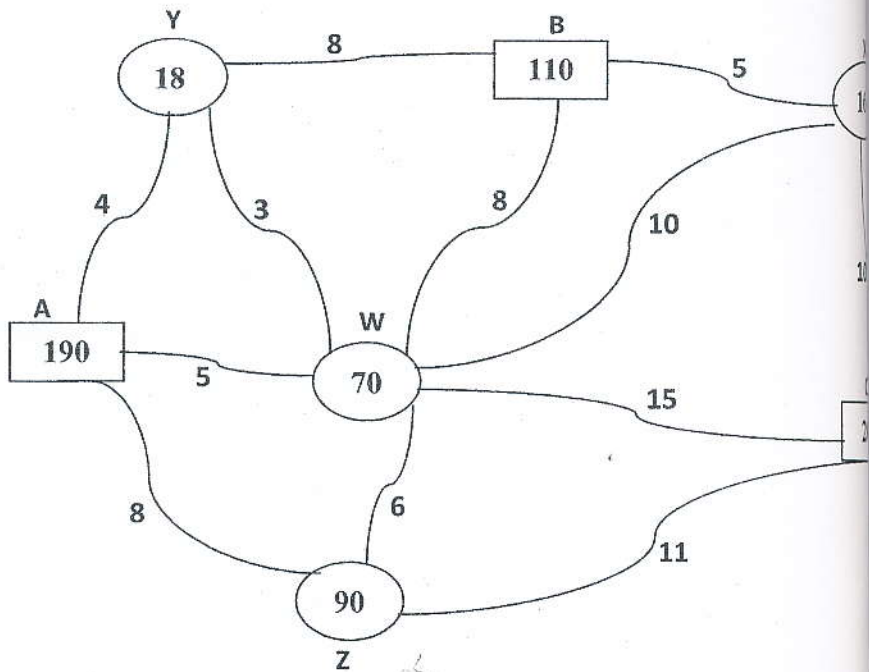
(b) Solve the following transportation problem for the **Maximum Total Profit**. There are two optional solutions. Show both.

Receiving
Points

| Sending Points | | 25 X | 25 Y | 25 Z | = 75 Total Demand |
|---|---|---|---|---|---|
| A | 20 | 8 | 6 | 10 | |
| B | 20 | 11 | 12 | 16 | |
| C | 20 | 4 | 7 | 9 | |

Available = 60

**(10 Marks)**

**(Total 20 Marks)**

Q3. (a) XYX Manufacturing firm has five employees and six machines and wants to assign the employees to the machines to minimize cost. A cost table that shows the cost (Rs.) incurred by each employee on each machine is as follows:

| Employee | Machine | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| 1 | 12 | 7 | 20 | 14 | 8 | 10 |
| 2 | 10 | 14 | 13 | 20 | 9 | 11 |
| 3 | 5 | 3 | 6 | 9 | 7 | 10 |
| 4 | 9 | 11 | 7 | 16 | 9 | 10 |
| 5 | 10 | 6 | 14 | 8 | 10 | 12 |

Solve this problem, indicate the optimal assignment, ánd compute total minimum cost.

**(10 Marks)**

(b) **Multiple Choice:** *Identify the choice that best completes the statement or answers the question.*

(01) The maximization or minimization of a quantity is the

(A) goal of management science.

(B) decision for decision analysis.

(C) constraint of operations research.

(D) objective of linear programming.

**(02)** Decision variables

**(A)** tell how much or how many of something to produce, invest, purchase, h

**(B)** represent the values of the constraints.

**(C)** measure the objective function.

**(D)** must exist for each constraint.

**(03)** Which of the following statements is NOT true?

**(A)** A feasible solution satisfies all constraints.

**(B)** An optimal solution satisfies all constraints.

**(C)** An infeasible solution violates all constraints.

**(D)** A feasible solution point does not have to lie on the boundary of the fea region

**(04)** A solution that satisfies all the constraints of a linear programming prob the nonnegativity constraints is called

**(A)** optimal.

**(B)** feasible.

**(C)** infeasible.

**(D)** semi-feasible.

**(05)** Slack

**(A)** is the difference between the left and right sides of a constraint.

**(B)** is the amount by which the left side of a $\leq$ constraint is smaller than the

**(C)** is the amount by which the left side of a $\geq$ constraint is larger than the r

**(D)** exists for each variable in a linear programming problem.

(Total

**Q4. Consider the following profit maximization problem.**

**Objective Function: Maximise,**

$$Z = 4X_1 + 5X_2 + 8X_3$$

Subject to:

$$2X_1 + 2X_2 + 3X_3 \leq 240$$
$$-3X_1 + 9X_2 + 3X_3 \leq 300$$
$$X_1, X_2, X_3 \geq 0$$

Where $X_1$, $X_2$ and $X_3$ are the amount to be produced from the three products $P_1$, $P_2$ and $P_3$ respectively.

(a) Complete the initial table of the above problem, and state the initial solution ($S_1$ and $S_2$ are the slack variables associated with two constraints).

(02 Marks)

(b) What is the first product that you wish to include in the basis, when applying the Simplex method? Give reasons, so that anybody would understand your answer.

(02 Marks)

(c) By how much can you increase the product selected in part (b)? Give reasons, so that anybody would understand your answer.

(02 Marks)

(d) Apply the simplex method, construct the next table, to improve the current solution?

(10 Marks)

(e) Interpret the solution of the table obtained in part (d) and describe any special characteristics that you observe in the table.

(04 Marks)

(Total 20 Marks)

**Q5. (a)** Following information are given to you with regard to a project. You are to draw the network diagram for this information and determine critical path duration and normal cost of the project. There is a fixed cost of Rs. 500/= p...

| Activity | Preceding Activity | Normal Duration in Months | Normal Cost (Rs.) |
|---|---|---|---|
| A | C, K | 6 | 50,000 |
| B | A, E, G | 4 | 60,000 |
| C | F, J | 7 | 50,000 |
| D | I | 10 | 40,000 |
| E | C, D, K | 5 | 50,000 |
| F | - | 2 | 35,000 |
| G | D | 6 | 75,000 |
| H | A, E | 3 | 30,000 |
| I | - | 2 | 10,000 |
| J | I | 3 | 25,000 |
| K | F | 9 | 75,000 |

**(b)** **Multiple Choice:** *Identify the choice that best completes the statement or the question.*

**(01)** The critical path

**(A)** is any path that goes from the starting event to the completion event.

**(B)** is a combination of all paths.

**(C)** is the shortest path.

**(D)** is the longest path.

**(02)** To determine how to crash activity times

**(A)** normal activity costs and costs under maximum crashing must be known.

**(B)** shortest times with crashing must be known.

**(C)** realize that new paths may become critical.

**(D)** all of the alternatives are true.

**(03)** In deciding which activities to crash, one must

**(A)** crash all critical activities.

**(B)** crash largest-duration activities.

**(C)** crash lowest-cost activities.

**(D)** crash activities on the critical path(s) only.

(04)  Which of the following is a general rule for crashing activities?

(A)  Crash only non-critical activities.

(B)  Crash activities with zero slack.

(C)  Crash activities with the greatest number of predecessors.

(D)  Crash the path with the fewest activities.


(05)  When activity times are uncertain,

(A)  assume they are normally distributed.

(B)  calculate the expected time, using $(a + 4m + b)/6$

(C)  use the most likely time.

(D)  calculate the expected time, using $(a + m + b)/3$.

**(05 Marks)**

(c)  ABC Computers wants to reduce a large stock of personal computers which is discontinuing. It has offered the University Bookstore at Tech a quantity discount pricing schedule if the store will purchase the personal computers in volume, as follows:

| Quantity | Price |
|----------|-------|
| 1–49 | $ 1,400 |
| 50–89 | $ 1,100 |
| 90 and Above | $ 900 |

The annual carrying cost for the bookstore for a computer is $190, the ordering cost is $2,500, and annual demand for this particular model is estimated to be 200 units. The bookstore wants to determine whether it should take advantage of this discount or order the basic EOQ order size.

**(05 Marks)**

Assume that the annual carrying cost for a computer at the University Bookstore is 15% of the purchase price. Using the same discount pricing schedule, determine the optimal order size. **(05 Marks)**

**(Total 25 Marks)**