Time: 3 Hours **Marks: 80**

Note :

1. **Question No.1 is compulsory.**
2. **Solve ANY THREE questions from the remaining five questions.**
3. **Figure to the right indicates full marks.**
4. **Assume suitable data wherever required, but justify the same.**

Q. 1 **Solve ANY FOUR from the following.**

a) Write the dual of the following primal problem **(5)**

Minimize $Z = 50x_1 + 60x_2$

S.T. $3x_1 + 30x_2 \geq 40$

$30x_1 + 4x_2 \geq 20$

$5x_1 + 16x_2 \geq 30$

$x_1, x_2 \geq 0$

b) Show graphically feasible bounded solution, unbounded solution, and infeasible solution with respect to linear programming problems **(5)**

c) State bellman's principle of optimality and briefly explain concept of dynamic programming **(5)**

d) A company manufactures two products A and B which requires the resources as machines M/c 1 and M/c 2 having the capacities of 40 and 15 hours respectively. Product A requires 1 hour of machine M/c 2. Product B requires 2 hours of machine M/c 1 and 2 hours of machine M/c 2. The profit contribution of products A and B are Rs. 5 and Rs 4 respectively. Show the problem formulation for profit maximization. **(5)**

e) What do you understand by full factorial and fractional factorial design? **(5)**

Q. 2 **a)** Solve the following Simplex problem **(10)**

Maximize $Z = 40x_1 + 30x_2$

S.T. $x_1 + x_2 \leq 40$

$x_1 - x_2 \leq 20$

$x_1, x_2 \geq 0$

b) What is integer linear programming? How does the optimal solution of an integer programming problem compare with that of the linear programming problem? **(5)**

c) Explain the Monte Carlo technique of simulation. **(5)**

Q. 3 **a)** Solve using SAW to select suitable area (A1, A2,..) for waste material dumping, having criteria as Cost (C1), distance from residential area (C2), distance (C3) from water resources as rivers, dams etc., and distance from main road (C4). Assume C1 as non-beneficial (NB), and rest all criteria as beneficial (B) **(10)**

No	Alternative	C1(Rs in Cr) 0.35 (NB)	C2(Kms) 0.25 (B)	C3 (kms) 0.25 (B)	C4(kms) 0.15 (NB)
1	A1	4	3	5	4
2	A2	2	4	3	3
3	A3	4	4	2	3
4	A4	4	3	4	3

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b) Classify optimization problems in detail. **(10)**

Q. 4 **a)** Using the Lagrange's multiplier method solve the following NLPP **(10)**

Optimize $Z = 4{x_1}^2 + 2{x_2}^2 + {x_3}^2 - 4\,x_1x_2$

S.T. $x_1 + x_2 + x_3 = 15$

$2x_1 - x_2 + 2x_3 = 20$

$x_1, x_2, x_3 \geq 0$

b) Describe step by step procedure of Genetic Algorithm. Draw a flow chart showing how a GA works. What are the termination conditions used in GA. **(10)**

Q. 5 **a)** A factory can manufacture two products A & B. The profit on one unit of A is Rs. 80 and one unit of B is Rs. 40. The maximum demand of A is 6 units per week and of B it is 8 units per week. The manufacturer has set up a goal of achieving a profit of exactly Rs. 640 per week. Show only the formulation of the problem as goal programming. **(05)**

b) Elaborate concept of dynamic programming **(05)**

c) Describe the procedure of AHP method step wise in detail. **(10)**

Q. 6 **a)** Write a note on Design of Experiment. **(5)**

b) Summarize the term 'Normalization' in MADM and list its different types. **(5)**

c) Explain the concept of Taguchi loss function with an example. **(5)**

d) Explain the terms 'Stationary Point' and 'Point of Inflection' with a graph. **(5)**

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