MANMOHAN TECHNICAL UNIVERSITY
Office of the Controller Examinations
2083 Bhadra Exam (2026 August) Model Question

School: Engineering	**Level:** Master	**Time:** 3 Hours
Program: M.Sc.P.S.E.	**Year/Part:** I/I	**Full Marks:** 50
Subject: EG806EE –Elective I- Operation Research and Optimization Techniques		**Pass Marks:** 25

✓ *Candidates are required to give their answers in their own words as far as practicable.*
✓ *The figures in the margin indicate Full Marks.*
✓ *Assume suitable data if necessary.*

GROUP A (Attempt any FIVE Questions) **[5x3=15]**

1. A distribution utility plans to install two types of distributed generation units at a substation. Each solar PV unit costs Rs. 8 lakhs, occupies 100 m² of land and delivers 50 kW of firm capacity. Each wind-power unit costs Rs. 5 lakhs, occupies 40 m² of land and delivers 80 kW of firm capacity. The utility has a capital budget of Rs. 80 lakh and only 800 m² of land is available. Formulate the problem as a linear programming problem (LPP) so as to maximize the total capacity installed.

2. Three generating stations S_1, S_2 and S_3 supply power to four load centers D_1, D_2, D_3 and D_4. The unit transmission costs (Rs. per MWh), the availabilities and the requirements are given in the table below. Obtain the initial basic feasible solution by the Least Cost Method and compute the corresponding total transmission cost.

	D_1	D_2	D_3	D_4	Supply
S_1	3	1	7	4	35
S_2	2	6	5	9	55
S_3	8	3	3	2	20
Demand	20	25	40	25	110

3. The optimal simplex table of the LPP: Maximize $Z = 7x_1 + 9x_2$ subject to $-x_1 + 3x_2 \leq 6$, $7x_1 + x_2 \leq 35$, $x_1, x_2 \geq 0$ and integers, is given below. Generate the Gomory fractional cut constraint from the x_2 row and write it in the form suitable for adding to the table.

Basis	x_1	x_2	s_1	s_2	Solution (X_B)
x_1	1	0	−1/22	3/22	9/2
x_2	0	1	7/22	1/22	7/2
$C_j - Z_j$	0	0	-28/22	-15/22	63

4. Minimize $f(x) = x^2 - 6x - 3$ by the unrestricted search method with a fixed step size of 0.1, starting from x = 0, in the interval [-1,3].

5. Three maintenance crews A, B and C are to be assigned to three feeders F_1, F_2 and F_3, one crew to one feeder. The outage cost (in thousand rupees) of every possible assignment is given below. Determine the optimal assignment and the minimum total cost using the Hungarian method.

Crew	F_1	F_2	F_3
A	11	17	8
B	9	7	12
C	13	16	15

6. Using the method of dynamic programming, maximize $z = x_1 \cdot x_2$ subject to $x_1 + x_2 = 4$ and $x_1, x_2 \geq 0$.

GROUP B (Attempt Any SEVEN Questions) **[7x5=35]**

Maximize $Z = 5x_1 + 4x_2$ subject to $6x_1 + 4x_2 \leq 24$, $x_1 + 2x_2 \leq 6$, $x_1 \geq 0$, $x_2 \geq 0$. Use graphical method.

2. Solve the following LPP by the simplex method, showing all simplex tables: Maximize $Z = 4x_1 + 3x_2$ subject to $2x_1 + x_2 \leq 10$, $x_1 + 3x_2 \leq 15$, $x_1 \geq 0$, $x_2 \geq 0$.

3. Solve the following LPP by dynamic programming, treating each decision variable as one stage: Maximize $Z = 3x_1 + 4x_2$ subject to $2x_1 + x_2 \leq 8$, $x_1 + 2x_2 \leq 10$, $x_1 \geq 0$, $x_2 \geq 0$.

4. Minimize $f(x) = x^2 - 8x + 20$ in the interval [0, 6] by the golden section method. Carry out iteration till final interval of uncertainty reduce to 10% of initial level of uncertainty.

5. Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $X_1 = (0, 0)^T$ using the Fletcher–Reeves conjugate gradient method.

6. Minimize $f(x_1, x_2) = x_1^2 + 2x_2^2 + 2x_1x_2 - 4x_1 - 6x_2$ starting from the point $X_1 = (0, 0)^T$ using the univariate method. Perform two iterations.

7. Two thermal units of a station supply a total load of 150 MW. Their fuel cost characteristics are $F_1 = 0.1P_1^2 + 20P_1 + 100$ Rs/h and $F_2 = 0.1P_2^2 + 30P_2 + 150$ Rs/h, where P_1 and P_2 are in MW. Using the Lagrangian multiplier method, determine the optimum generation schedule (P_1, P_2), the value of the multiplier λ and the minimum total fuel cost.

8.Optimize $f(x_1, x_2) = 8x_1 + 12x_2 - x_1^2 - x_2^2$ subject to $x_1 + 2x_2 \leq 6$, $x_1 \geq 0$, $x_2 \geq 0$.

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