Registration No : | | | | | | | | | | |

Total Number of Pages : 03

B. Tech/
IDD (B.Tech and M.Tech)
ROE6A001

6th Semester Regular/Back Examination: 2025
Optimization in Engineering
AE, AEIE, AERO, AG, AME, AUTO, BIOMED, BIOTECH, C&EE, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, EIE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, IT, MANUTECH, MECH, METTA, MINERAL, MINING, MME, MMEAM, PLASTIC, PT
Time : 3 Hour
Max Marks : 100
Q.Code : S002

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions :** **(2 x 10)**

a) Define convex set.
b) Write the basic difference between slack variable and artificial variable.
c) How to identify degenerate solution in a transportation problem?
d) What is golden ratio?
e) Optimal feasible solution of a non-linear programming problem always attains at the corner point of the feasible space. True or False? Justify.
f) Lagrange multiplier method is used to find local / global optimum value of a NLP. Find the correct one with justification.
g) Find the criteria that KKT condition becomes sufficient for a Nonlinear programming problem.
h) Define M/M/S model.
i) What is balking in queueing theory?
j) Write an application of optimization techniques in engineering.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 × 8)**

a) Solve using graphical method: $Max\ Z = 5x + 2y$ subject to $x + y \geq 5$, $x - y \leq 5$, $x, y \geq 0$.
b) Solve using simplex method, $Max\ Z = x + y$ subject to $25x + 15y \leq 250$, $20x + 10y \leq 175$, $x, y \geq 0$.
c) Solve using Big-M method, $Max\ Z = 3x + 2y$ subject to $2x + y \leq 2$, $3x + 4y \geq 12$, $x, y \geq 0$.
d) Write a short note on sensitivity analysis.
e) State strong duality theorem. Find the dual of the given LPP: $Max\ Z$ =x+$3y$ subject to $x + y \leq 3$, $2x - y \geq 9$, $x + 3y = 7$, $x \geq 0$, y is

unrestricted.

f) Solve by dual simplex method, $Max\ Z = -3x - y$ subject to $-x - y \leq -1$, $-2x - 3y \leq -2$, x, y≥ 0.

g) Solve the integer programming problem $\boldsymbol{Max\ Z = x + y}$ subject to $\boldsymbol{3x + 2y \leq 12}$, $\boldsymbol{y \leq 2}$, $\boldsymbol{x, y}$ are integers $\geq \mathbf{0}$.

h) A company has four workers and four jobs to be completed. Each worker must be assigned to complete one job. The time required to finish each job by individual worker is shown in the table below. Company wants to minimize the total time needed to complete the four jobs. Find the optimal assignment.

Jobs	A	B	C	D
Worker 1	5	3	2	8
Worker 2	7	9	2	6
Worker 3	6	4	5	7
Worker 4	5	7	7	8

i) Find minimum value of F(x,y,z) $= x^2 + y^2 + z^2$ subject to $2x + y + z = 9$ and $5x + 5y + 7z = 29$.

j) Solve Min f(x,y) $= 2x +$ y subject to $x^2 + y^2 \leq 4,\ x \leq y$.

k) Using Golden section search find the value of x that minimizes $f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the interval $[0,2]$. Locate the value of x lies within the interval of length 0.3.

l) Arrivals to an airport with a single runway are Poisson distributed with a rate of 25 per hour. The average time to land an aircraft is 80 seconds and this time is exponentially distributed. Find the utilization of the runway, average waiting time in the system and average length of the system.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) Find the size of interval containing the minimizer after sixth iteration using Fibonacci search for the problem Min f(x) $= x^2 - \sin x$ with initial interval [0,1]. **(8+8)**

b) One manufacturing company manufactures two products A and B. Both the products are processed on two machines M and N. The data provided as follows:

	$\boldsymbol{Hours}$ **per**	**Required unit**	$Profit\ per\ unit$
Products	M	N	5
A	1	3	30
B	2	2	20
$capacity\ per\ week\ (hours)$	80	120	

Find out how many units of A and B should be produced per week in order to maximize the profit?

Q4 Minimize the transportation cost for the problem given below using MODI method **(16)**

	D_1	D_2	D_3	D_4	$supply$
O_1	6	3	5	4	22
O_2	5	9	2	7	15
O_3	5	7	8	6	9
$Demand$	7	12	17	9	

Q5 Solve the quadratic problem Max f(x,y) $= -2x^2 - 2y^2 - 2xy + 4x + 6y$ subject to $x + 2y \leq 2$, $x, y \geq 0$. **(16)**

Q6 Consider an M/M/1 queueing system in which expected waiting time and expected number of customers in the system are one minute and 10 customers, respectively. Determine the probability that a customer's service time exceeds 10 seconds. Find traffic intensity of M/M/5 model. **(14+2)**