



M.E. DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Second Semester

INDUSTRIAL ENGINEERING

P18IET2005: Deterministic Operations Research

COURSE OUTCOMES

- CO1:** Formulate mathematical models for engineering problems.
- CO2:** Apply the linear and integer programming techniques to solve problems on linear programming extensions.
- CO3:** Employ transportation, assignment and networking models for industrial problems.
- CO4:** Understand dynamic programming solutions through principles of optimality.
- CO5:** Apply classical optimization theory for constrained and unconstrained optimization models.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Assertion (A): In two phase method, we introduce artificial variables into the constraint equation. Along with these variables the problem is solved for an optimal solution. Reason (R): The introduction of artificial variable is to get starting basic feasible solution, so that simplex procedure may be used as usual until the optimal solution is obtained. CO1 [K₂]
- a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
- c) A is true but R is false d) A is false but R is true
2. Sensitivity analysis is used to study the _____ CO2 [K₁]
- a) The effect of discrete changes in parameters on the optimal solution b) Change the sign of variables on other variables
- c) Change the sign of constraint equation d) Change in the objective function value
3. A feasible solution is said to be _____ if it minimizes the total transportation cost. CO3 [K₁]
- a) Basic feasible solution b) Degenerate solution
- c) Non degenerate solution d) Optimal solution

4. Matching type item with multiple choice code

CO3 [K₁]

List I	List II
A. Optimistic time	i. Time when some sort of uncertainty and many a time the things will go right
B. Pessimistic time	ii. Time when everything goes well
C. Normal time	iii. Longest time of any project
D. Critical duration	iv. Time when everything goes wrong

- | | A | B | C | D |
|----|----|----|-----|-----|
| a) | ii | i | iii | iv |
| b) | i | iv | ii | iii |
| c) | ii | iv | i | iii |
| d) | iv | i | ii | iii |

5. Assertion (A): Crash cost is always less than the normal cost.

CO3 [K₂]

Reason (R): Crashing of project network is carried out by additional resources or taking other measures to speed up the process

- | | |
|---|---|
| a) Both A and R are Individually true and R is the correct explanation of A | b) Both A and R are Individually true but R is not the correct explanation of A |
| c) A is true but R is false | d) A is false but R is true |

6. Forward and backward recursion is used in _____

CO4 [K₁]

- | | |
|------------------------|------------------------|
| a) Linear programming | b) Integer programming |
| c) Dynamic programming | d) Simplex Method |

7. The techniques that are used to solve the constrained optimization problem are,

CO5 [K₁]

- Kuhn Tucker conditions
- Newton Raphson method
- Lagrange multiplier method
- Hungarian method

- | | |
|---------------|---------------|
| a) 2,3,4 only | b) 1,2,4 only |
| c) 1,2,3 only | d) 1,3,4 only |

8. Assertion (A): Lagrangian function is used to determine the minimum or maximum value of a function subject to the equality constraint.

CO5 [K₂]

Reason (R): The method of Lagrange's multipliers is an important technique applied to determine the local maxima and minima of a function.

- | | |
|---|---|
| a) Both A and R are Individually true and R is the correct explanation of A | b) Both A and R are Individually true but R is not the correct explanation of A |
| c) A is true but R is false | d) A is false but R is true |

9. Integer programming problem is one of the special case of _____

CO4 [K₂]

- | | |
|---------------------------|-------------------------------|
| a) Assignment problem | b) Linear Programming problem |
| c) Transportation problem | d) Unconstrained problem |

23. A dairy plant has five milk tankers I, II, III, IV & V. These milk tankers are to be used on five delivery routes A, B, C, D, and E. The distances (in kms) between dairy plant and the delivery routes are given in the following distance matrix. How the milk tankers should be assigned to the chilling centers so as to minimize the distance travelled? CO3 [K₃]

	I	II	III	IV	V
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	155	170	185
D	50	50	80	80	110
E	55	35	70	80	105

24. A company manufacturing plant and equipment for chemical processing is in the process of quoting tender called by public sector undertaking. Help the manager to find the project completion time to participate in the tender. The time taken for all the activity in this project are given in the following table. CO3 [K₃]

S.No.	Activity	Predecessor	Duration (Days)
1	A	-	3
2	B	-	4
3	C	A	5
4	D	A	6
5	E	C	7
6	F	D	8
7	G	B	9
8	H	E,F,G	3

25. Enumerate the steps in Gomory Cutting Plane Algorithm used to solve the integer programming problem with suitable example. CO2 [K₂]
26. Elaborate the characteristic features of dynamic programming problem. CO4 [K₃]
27. Distinguish between assignment and transportation problem. CO3 [K₂]
28. Elaborate the development of Operations Research over the period from its inception and discuss in detail. CO1 [K₂]
29. Minimize $f(x) = x^2 + (54/x)$ using Newton Raphson method. CO5 [K₃]
30. Minimize $f(x,y) = x^2 + y^2$ subjected to,
 $x + 2y - 5 = 0$ using Lagrange Multiplier method. CO5 [K₃]

Answer any TWO Questions

PART D (2 x 10 = 20 Marks)

31. A company manufactures two products, X and Y by using three machines A, B, and C. Machine A has 4 hours of capacity available during the coming week. Similarly, the available capacity of machines B and C during the coming week is 24 hours and 35 hours respectively. One unit product X requires one hour of Machine A, 3 hours of machine B and 10 hours of machine C. Similarly one unit of product Y requires 1 hour, 8 hour and 7 hours of machine A, B and C respectively. When one unit of X is sold in the market, it yields a profit of Rs. 5/- per product and that of Y is Rs. 7/- per unit. Solve the problem by using graphical method to find the optimal product mix. CO1 [K₃]

32. A small project is composed of 7 activities whose time estimates are listed below. Activities are being identified by their beginning (i) and ending (j) node numbers. CO3 [K₃]

Activities		Time in weeks		
i	j	a	m	b
1	2	1	1	7
1	3	1	4	7
1	4	2	2	8
2	5	1	1	1
3	5	2	5	14
4	6	2	5	8
5	6	3	6	15

Draw the network and calculate the expected project completed time and the probability that the project will be completed at least 3 weeks than expected.

33. Solve the following integer programming problem using branch and bound technique. CO2 [K₃]

Maximize $Z=3X_1+5X_2$,

Subject to,

$2X_1+4X_2 \leq 25$

$X_1 \leq 8$

$2X_2 \leq 10$

$X_1, X_2 \geq 0$ and Integers
