KAI-1658

M. A. / M. Sc. (Final) Examination, 2025

MATHEMATICS

PAPER - I

(OPTIONAL)

OPERATIONS RESEARCH

(Only for Due/Ex Students)

Time allowed : **Three Hours**

Max. Marks : **100**

Note : *Non-programmable Scientific Calculator is allowed in this paper.*

This question paper contains three sections as under:

SECTION-A *खण्ड–अ* ***Max. Marks - 10***

This section contains ***one compulsory*** *question with* ***10*** *parts having two parts from each unit. Answer of each part should not exceed 20 words. All questions carry* ***equal*** *marks.*

इस खण्ड में एक ***अनिवार्य*** *प्रश्न हैं, जिसमें प्रत्येक इकाई से* ***02*** *लघु प्रश्न लेते हुए कुल* ***10*** *लघु प्रश्न होगे। जिसमें* ***10*** *भाग हैं। प्रत्येक भाग का उत्तर* ***20*** *शब्दों से अधिक न हो। सभी प्रश्नों के अंक* ***समान*** *हैं।*

SECTION-B *खण्ड–ब* ***Max. Marks - 50***

This section contains ***10*** *questions having two questions from each unit. Attempt* ***5*** *questions in all, selecting one question from each unit. Answer of each question should not exceed* ***250*** *words. All questions carry* ***equal*** *marks.*

इस खण्ड में प्रत्येक इकाई से लेते हुए कुल ***10*** *प्रश्न है। प्रत्येक इकाई से एक प्रश्न का चयन करते हुये, कुल* ***05*** *प्रश्नों के उत्तर दीजिये। प्रत्येक प्रश्न का उत्तर* ***250*** *शब्दों से अधिक न हो। सभी प्रश्नों के अंक* ***समान*** *हैं।*

SECTION-C *खण्ड–स* ***Max. Marks - 40***

This section contains ***04*** *Descriptive type questions (questions may have sub division). This section will cover all units but not more than one question from each unit. Attempt* ***02*** *questions in all. Answer of each question should not exceed* ***500*** *words. All questions carry equal marks.*

इस खण्ड में ***04*** *प्रश्न हैं, प्रश्न के भाग हो सकते हैं। इस खण्ड में एक इकाई से अधिकतम एक प्रश्न होगा। कुल दो प्रश्नों के उत्तर दीजिये। प्रत्येक प्रश्न का उत्तर* ***500*** *शब्दों से अधिक न हो। सभी प्रश्नों के अंक समान हैं।*

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SECTION - A

1 (i) Write difference between Simplex and Dual Simplex methods.

(ii) Define Sensitivity Analysis.

(iii) Define two person zero-sum game.

(iv) Define inter programming problem.

(v) Define PERT.

(vi) What is dynamic programming.

(vii) Write advantages of inventory.

(viii) Write K.T. condition for the general Nonlinear programming problem.

(ix) Define quadratic programming problem.

(x) Define idle period in queuing theory.

SECTION - B

UNIT - I

2 Solve the following L.P.P. by two phase method:

Min. $Z = 2x_1 + 9x_2 + x_3$

S.t. $x_1 + 4x_2 + 2x_3 \geq 5$

$3x_1 + x_2 + 2x_3 \geq 4$

and $x_1, x_2, x_3 \geq 0$

3 Solve the following problem by dual-simplex method:

Min. $Z = 2x_1 + x_2$

S.t. $3x_1 + x_2 \geq 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \geq 3$

and $x_1, x_2 \geq 0$

UNIT - II

4 Solve the following 2×3 game by graphical method

$$(A)\begin{matrix} \\ x_1 \\ (1-x_1) \end{matrix}\begin{matrix} (B)\ y_1\ y_2\ y_3 \\ \text{I}\ \ \text{II}\ \ \text{III} \\ \text{I} \\ \text{II} \end{matrix}\begin{bmatrix} 1 & 3 & 11 \\ 8 & 5 & 2 \end{bmatrix}$$

5 Use Branch and Bound technique to solve the following problem:

Max. $Z = 7x_1 + 9x_2$

S.t. $-x_1 + 3x_2 \leq 6$

$7x_1 + x_2 \leq 35$

$x_1 \leq 7$

$x_2 \leq 7$

and $x_1, x_2 \geq 0$; x_1, x_2 are integers.

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UNIT - III

6 Construct a network for the project whose activities and their precedence relationships are given below:

Activity	A	B	C	D	E	F	G	H	I	J	K
Immediate predecessor	–	–	–	A	B	B	C	D	E	H, I	F, G

7 Use dynamic programming to find maximum value of $y_1\ y_2\ y_3$ subject to $y_1 + y_2 + y_3 = 15$ and $y_1, y_2, y_3 \geq 0$.

UNIT - IV

8 An item is produced at the rate of 50 items per day. The demand occurs at the rate of 25 items per day. If the setup cost is Rs. 100 per setup and holding cost is Rs. 0.01 per unit of item per day.
Find the EOQ for one run assuming that the shortages are not permitted.

9 Solve the following by using Kuhn-Tucker conditions:

Max. $f(x) = 4x_1 + 2x_2 - x_1^2 - x_2^2 - 5$

Subject to $x_1 + x_2 \leq 4$

and $x_1, x_2 \geq 0$

UNIT - V

10 Use Beale's method to solve the following quadratic programming problem:

Min. $Z = 10x_1^2 + x_2^2 + 4x_1x_2 - 10x_1 - 25x_2$

S.t. $x_1 + 2x_2 \leq 10$

$x_1 + x_2 \leq 9$

and $x_1, x_2 \geq 0$

11 If for a period of 2 hours in a day (7 A.M. to 9 A.M.) customers arrive in a barber's shop that has space to accommodate only 4 customers. Arrival rate of customers is 3/hour and service time is 36 minutes/customer. Find:

(a) The probability that there is no customers in the shop.

(b) Average number of customers in the shop.

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SECTION - C

12 Solve the mix IPP by using Gomory's method

Max. $Z = x_1 + x_2$

S.t. $3x_1 + 2x_2 \leq 5$

$x_2 \leq 2$

and $x_1, x_2 \geq 0$ and are integer.

13 A project has a following time estimates in days:

Activity	Optimistic (t_o)	Most likely (t_m)	Pessimistic (t_p)
(1, 2)	3	6	15
(1, 6)	2	5	14
(2, 3)	6	12	30
(2, 4)	2	5	8
(3, 5)	5	11	17
(4, 5)	3	6	15
(5, 8)	1	4	7
(6, 7)	3	9	27
(7, 8)	4	19	28

(i) Draw the project network.

(ii) Find the critical path.

(iii) Find the event slack for each event.

(iv) Find the probability that the project is completed is 31 days.

14 Find the optimal solution of L.P.P.

Max. $Z = 3x_1 + 5x_2$

S.t. $3x_1 + 2x_2 \leq 18$

$x_1 \leq 4$

$x_2 \leq 6$

and $x_1, x_2 \geq 0$

Discuss the effect on the optimality of the solution when the objective function is changed to $Z = 3x_1 + x_2$.

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15 Solve the following QPP by Wolfe's method:

Min. $Z = -10x_1 - 25x_2 + 10x_1^2 + x_2^2 + 4x_1x_2$

S.t. $x_1 + 2x_2 \leq 10$

$x_1 + x_2 \leq 9$

and $x_1, x_2 \geq 0$