

AOR-01

ASSIGNMENT BOOKLET

OPERATIONS RESEARCH

Valid from 1st Jan, 2026 to 31st Dec, 2026



**School of Sciences
Indira Gandhi National Open University
Maidan Garhi
New Delhi-110068
(2026)**

Dear Student,

Please read the section on assignments in the Programme Guide that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

- 1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.:

NAME:

ADDRESS:

.....

.....

COURSE CODE:

COURSE TITLE:

ASSIGNMENT NO.:

STUDY CENTRE: **DATE:**

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

- 2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
- 3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
- 4) Your answers should be precise.
- 5) While solving problems, clearly indicate which part of which question is being solved.
- 6) This assignment is **valid from 1st Jan, 2026 to 31st Dec, 2026**. If you have failed in this assignment or fail to submit it by Dec, 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.
- 7) **You cannot fill the examination form for this course** until you have submitted this assignment.

We strongly suggest that you retain a copy of your answer sheets.

We wish you good luck.

Assignment (To be done after studying all the blocks)

Course Code: AOR-01
Assignment Code: AOR-01/TMA/2026
Maximum Marks: 100

1. Which of the following statements are true? Give reasons for your answers. (10)

- i) If an item is ordered frequently, then the risk of running out of stock is least.
- ii) In deterministic queuing model, arrival rate must not exceed the service rate.
- iii) The critical path of a project network represents the minimum time needed to complete the project.
- iv) A necessary and sufficient condition for a basic feasible solution for a minimization LPP to be optimum is that all $Z_j - C_j \geq 0$.
- v) If dual has an unbounded solution, primal has a feasible solution.

2. a) A firm produces three products A, B and C. It uses two types of raw materials I and II of which 5000 and 7500 units respectively are available. The raw material requirements per unit of the products are given below: (5)

Raw Material	Requirement per unit of product		
	A	B	C
I	3	4	5
II	5	3	5

The minimum demand of the three products is 600, 650 and 500 units respectively. Assuming the profits per unit of A, B and C as ₹ 50, ₹50 and ₹80 respectively. Formulate the problem as LPP model in order to determine the number of units of each product which will maximize the profit.

b) Use the graphical method to solve the following LPP: (5)

Maximize:

$$z = 2x_1 + 3x_2$$

Subject to the constraints:

$$x_1 + x_2 \leq 30$$

$$x_1 - x_2 \geq 0$$

$$x_2 \geq 3$$

$$0 \leq x_1 \leq 20$$

and $0 \leq x_2 \leq 12$.

3. a) Use simplex method to solve the following LPP: (5)

Maximize:

$$z = 2x_1 - x_2 + x_3$$

Subject to the constraints:

$$3x_1 + x_2 + x_3 \leq 60$$

$$x_1 - x_2 + 2x_3 \leq 10$$

$$x_1 + x_2 - x_3 \leq 20$$

and $x_1, x_2, x_3 \geq 0$.

- b) Give the dual of the following LPP: (5)

Minimize:

$$z = 2x_1 + 3x_2 + 4x_3$$

Subject to the constraints:

$$2x_1 + 3x_2 + 5x_3 \geq 2$$

$$3x_1 + x_2 + 7x_3 = 3$$

$$x_1 + 4x_2 + 6x_3 \leq 5$$

$x_1, x_2 \geq 0$ and x_3 is unrestricted.

4. a) Use two-phase method to solve the following LPP: (5)

Maximize:

$$z = 3x_1 + 2x_2$$

Subject to the constraints:

$$2x_1 + x_2 \leq 2$$

$$3x_1 + 4x_2 \geq 12$$

$$x_1, x_2 \geq 0$$

- b) Use dual simplex method to solve the following LPP: (5)

Minimize:

$$z = 3x_1 + x_2$$

Subject to the constraints:

$$x_1 + x_2 \geq 1$$

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

$$x_1, x_2 \geq 0.$$

5. a) Given $x_{13} = 50$ units, $x_{14} = 20$ units, $x_{21} = 55$ units, $x_{31} = 30$ units, $x_2 = 35$ units and $x_{34} = 25$ units. Is it an optimal solution to the transportation problem: (5)

				Available units	
	6	1	9	3	70
	11	5	2	8	55
	10	12	4	7	90
Required units	85	35	50	45	

If not, modify it to obtain a better feasible solution.

- b) In a factory, there are six jobs to perform each of which should go through two machines A and B in the order A B. The processing timings (in hours) for the jobs are given here. You are required to determine the sequence for performing the jobs that would minimize the total elapsed time T, what is the value of T? (5)

Job	Machine A	Machine B
J ₁	1	5
J ₂	3	6
J ₃	8	3
J ₄	5	2
J ₅	6	2
J ₆	3	10

6. a) The time taken (in hours) by five different machines for completing five different jobs is given below: (5)

		Machines				
		A	B	C	D	E
Jobs	I	10	5	13	15	16
	II	3	9	18	13	6
	III	10	7	2	2	2
	IV	7	11	9	7	12
	V	7	9	10	4	12

Find the optimal assignment.

- b) A manufacturing company needs 2500 units of a particular item every year. The company buys it at the rate of ₹ 30 per unit. The order processing cost for this item is estimated at ₹ 15 and the cost of carrying a item in stock comes to about ₹ 4 per year. The company can manufacture this item internally. In that case it saves 20% of the price of the product. However, it estimates a set-up cost of ₹ 250 per production run. The annual production rate would be 4800 units. However, the inventory holding costs remain unchanged. (5)
- i) Determine the EOQ and the optimal number of orders placed in a year.
 ii) Determine the optimum production lot size and the average duration of the production run.
7. a) On an average 96 patients per 24-hour a day require the services of an emergency clinic. Also on an average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic ₹ 100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost ₹ 10 per patient treated. How much would have to budgetted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ a patient? (5)
- b) A project schedule has the following characterizing: (5)

Activity	Time
1 – 2	4
1 – 3	1
2 – 4	1
3 – 4	1
3 – 5	6
4 – 9	5
5 – 6	4
5 – 7	8
6 – 8	1
7 – 8	2
8 – 10	5
9 – 10	7

- i) Construct PERT network.
- ii) Find the critical path.

8. a) A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and make reservations. Consumers arrive at a rate of 8 per hour and the clerk can service 12 customers on an average per hour. (5)

- i) What is the average number of customers waiting for the service of the clerk?
- ii) What is the average time a customer has to wait before getting service?

- b) Use branch and bound method to solve the following LPP: (5)

Minimize:

$$Z = 4x_1 + 3x_2$$

Subject to the constraints:

$$5x_1 + 3x_2 \geq 30$$

$$x_1 \leq 4$$

$$x_2 \leq 6$$

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

9. a) At present a company is purchasing an item 'x' from outside suppliers. The assumption of unit is 10000 units/year. The cost of the item is ₹ 5 per unit and the ordering cost is estimated to be ₹ 100 per order. The cost of carrying inventory is 25%. If the consumption rate is uniform, determine the economic order quantity. (5)

- b) Obtain all the basic solutions to the following system of linear equations:

$$x_1 + 2x_2 + x_3 = 4$$

$$2x_1 + x_2 + 5x_3 = 5$$

Which of the solutions are feasible? Justify. (5)

10. a) A sales manager wishes to assign four sales territories to four salespersons. The salespersons differ in their ability and skills and consequently the sales expected in

each territory are different. The estimates of sales per month for each sales-person in different territories are given below:

Sales- persons	Estimated Monthly Sales Territory			
	I	II	III	IV
A	20	40	45	30
B	50	40	55	40
C	45	40	42	50
D	48	50	42	45

Find the optimal assignment of the four salespersons to the four different territories and the maximum monthly sales.

(5)

b) Find the optimum solution to the following transportation problem:

(5)

Factory	Warehouse				Capacity
	D	E	F	G	
A	42	48	38	37	160
B	40	49	52	51	150
C	39	38	40	43	190
Demand	80	90	110	160	