AOR-01

ASSIGNMENT BOOKLET

Bachelor's Degree Programme

OPERATIONS RESEARCH
(Valid from 1st January, 2021 to 31st December, 2021)

It is compulsory to submit the assignment before filling the exam form.

School of Sciences
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(2021)

Dear Student,

Please read the section on assignments in the Programme Guide for Elective Courses 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: ……

……

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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 only upto December, 2021**. If you have failed in this assignment or fail to submit it by the last date, then you need to get the assignment for the next cycle and submit it as per the instructions given in that assignment.

7) It is compulsory to submit the assignment before filling in the exam form.

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

ASSIGNMENT

Course Code: AOR-01
Assignment Code: AOR-01/TMA/2021
Maximum Marks: 100

1. Which of the following statements are true and which are false? Give a short proof or a counter example in support of your answer. (10)

   (a) The optimal solution for the following LPP is $Z^* = 30$:
   Max $Z = x_1 - x_2 + 3x_3$
   Subject to $x_1 + x_2 + x_3 \leq 10$
   $x_1, x_2, x_3 \geq 0.$

   (b) The optimal solution of an ILLP can be obtained by rounding off the optimal solution of its LP relaxation.

   (c) If the availabilities and requirements of a balanced transportation problem are integers, the optimal solution to the problem will have integer values.

   (d) The following $4/3/F/F_{\max}$ problem can be reduced to a machine problem.

Job	Processing time on		
	M_1	M_2	M_3
1	8	6	10
2	5	2	13
3	4	11	11
4	6	7	10

   (e) For the mixed generator $r_{n+1} = (5r_n + 7) \pmod 8$, if $r_0 = 4$, then r_3 is zero.

2. (a) A firm makes two products A and B has a total production capacity of 9 tonnes per day, with A and B utilizing the same production facilities. The firm has a permanent contract to supply at least 2 tonnes of A per day to another company. Each tone of A requires 20 machine hours of production time and each tone of B requires 50 machine hours of production time. The daily maximum possible number of machine hours is 360. All the firm's output can be sold and the profit made is Rs. 80 per tonne of A and Rs. 120 per tonne of B. Formulate the problem of maximising the profit as an LPP and solve it graphically. (5)

   (b) Find the sequence of jobs that minimizes the total elapsed time required to complete the following task on two machines.

Task	A	B	C	D	E	F	G
I	2	5	4	9	8	5	4

II	6	8	7	4	9	8	11

Also, find the optimal elapsed time.

3. (a) A company has three factories F_1, F_2 and F_3 which supply goods to four warehouses W_1, W_2, W_3 and W_4. The daily factory capacities of F_1, F_2 and F_3 are, respectively, six units, one unit and ten units. The demand of the warehouses W_1, W_2, W_3 and W_4 are, respectively, seven, five, three and two units. Unit transportation cost are as follows: (5)

	W_1	W_2	W_3	W_4
F_1	2	3	11	7
F_2	1	0	6	1
F_3	5	8	15	9

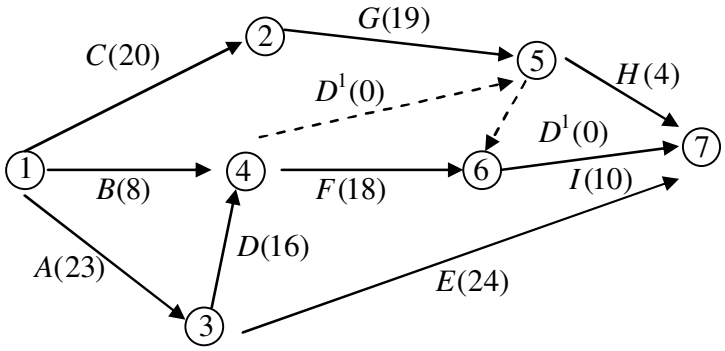
Find an initial basic feasible solution by the Vogel's approximation method.

(b) Three custom officers check the luggage of the passengers of an airport. The passengers are found to arrive at an average rate of 30 per 8 hours a day. The amount of time a custom officer spends with the passenger is found to have an exponential distribution with mean service time 32 minutes. (5)

(i) Find the probability that all the custom officers are idle.
(ii) Find the expected number of passengers in the queues.
(iii) Find the expected waiting time of passenger in the system.

4. (a) A television repairman finds that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs sets in the order in which they come in, and if arrival of sets follows a Poission distribution approximately with an average rate of 10 per 8 hours day, what is the repairman's expected idle time each day, How many jobs are ahead of the average set just brought in? (4)

(b) Find the critical path for the project whose network diagram is given below. (6)



5. (a) Use the simplex method to solve the following L.P.P. (5)

Max $z = 4x_1 + 3x_2$

Subject to

$2x_1 + x_2 \leq 1000$

$x_1 + x_2 \leq 800$

$x_1 \leq 400$

$x_2 \leq 700$

$x_1, x_2 \geq 0.$

(b) A department has five employees with five jobs to be performed. The time (in hours) each men will take to perform each job is given in the table below: (5)

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

How should the jobs be assigned, one job per employee, so as to minimize the total man-hours?

6. (a) A contractor has to supply 10,000 bearings per day to an automobile manufacturer. He finds that when he starts production run, he can produce 25,000 bearings per day. The cost of holding a bearing in stock for one year is Rs. 2 and the set up cost of a production run is Rs. 180. Find the EOQ. How frequently should the production run he made? (5)

(b) Based on the previous data, the probabilities of a batsman making various scores in One Day Internationals are given below: (5)

Runs	10	20	30	50	60	70	100
Probability	0.01	0.20	0.15	0.30	0.12	0.2	0.02

Simulate the runs scored by the batsman in the next five One Day Internationals using the following 25, 39, 65, 76, 12.

7. Use dual simplex method to solve the following LPP. (10)

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

Subject to

$x_1 - x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \leq 8$

$x_1 - x_3 \geq 2$

$x_1, x_2, x_3 \geq 0.$

8. (a) Write the dual of the following LPP: (5)

Minimize $Z = 16x_1 + 9x_2 + 21x_3$

Subject to the constraints

$x_1 + x_2 + x_3 = 16$

$2x_1 + x_2 + x_3 \geq 12$

$x_1, x_2 \geq 0$

x_3-unrestricted.

(b) A trading company buys and sells 10,000 bottles of pain-balm every year. The company's cost of placing an order of pain-balm is Rs. 100. The holding cost per bottle on inventory is Rs. 0.3. (5)

(i) Determine the optimum order quantity and inventory cycle time for the pain-balm, bottles.

(ii) How many orders should be placed each year?

9. Solve the ILLP given below by graphical method: (10)

Maximum $Z = 95x_1 + 100x_2$

Subject to the Constraints

$5x_1 + 2x_2 \leq 20$

$x_1 \geq 3$

$x_2 \leq 5$

$x_1\, x_2$ are non-negative integers.

10. The optimal solution of a maximization type LPP is given in the following table: (10)

$C_j's$		6	4	0	0	0	Solution
CB Basic Variables		x_1	x_2	x_3	x_4	x_5	
0	x_3	0	5/3	1	$-2/3$	0	14
0	x_5	0	$-1/3$	0	1/3	1	5
6	x_1	1	2/3	0	1/3	0	8
$C_j - Z_j$		0	0	0	-2	0	$Z = 48$

(i) Find the alternative optimal basic feasible solution.

(ii) Find an alternative optimal non-basic feasible solution.