APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester MCA (Two Year) Degree Regular and Supplementary Examination December 2022

Course Code: 20MCA261
Course Name: OPERATIONS RESEARCH

Max. Marks: 60   Duration: 3 Hours

PART A
Answer all questions, each carries 3 marks.   Marks

1   Define Slack and Surplus variables. Explain their role in LPP.   (3)

2   What do you mean by a basic solution in LPP? Find all basic solutions of $2x_1 +$ (3)
    $x_2 + 4x_3 = 11$ and $3x_1 + x_2 + 5x_3 = 14$.

3   State the Complementary slackness theorem and Fundamental theorem of duality.   (3)

4   Write the dual of the following primal LP Problem.   (3)
    $$MinZ = 12x_1 + 3x_2 + 7x_3 \quad \text{Subject to}$$
    $$6x_1 - 2x_2 + 5x_3 \geq 3$$
    $$-2x_1 - 3x_2 + 4x_3 \leq 2$$
    $$3x_1 + 9x_2 + x_3 \geq 8$$
    $$x_1, x, x_3 \geq 0.$$

5   Discuss how an unbalanced assignment problem can be solved. Give example.   (3)

6   Obtain an initial basic feasible solution to the following Transportation problem (3)
    using the matrix minima method (Lowest Cost entry method)

	D_1	D_2	D_3	D_4	Capacity
O_1	21	16	25	13	11
O_2	17	18	14	23	13
O_3	32	27	18	41	19
Demand	6	10	12	15	

Where O_i and D_j denote i^{th} origin and j^{th} destination respectively.

7   Explain the time estimates considered in PERT analysis.   (3)

8   A small project consists of 6 activities for which the relevant data is given below (3)

Activity	:	A	B	C	D	E	F
Preceding activities:		-	A	A	B	B,C	D,E
Duration(days)	:	3	5	4	6	7	4

Draw the network and find the project completion time.

9   State and explain in brief Kendall's notation for representing queuing models.   (3)

10   What is queue behaviour? Explain different behaviour of customers in a queue.   (3)

PART B

Answer any one question from each module. Each question carries 6 marks.

Module I

11   Solve the following Linear Programming Problem using Simplex method.   (6)

$$MaxZ = x_1 + 2x_2 + 3x_3 \quad \text{Subject to}$$

$$3x_1 + 2x_2 + x_3 \leq 3$$
$$2x_1 + x_2 + 2x_3 \leq 2$$
$$x_1, x, x_3 \geq 0.$$

OR

12   Use Big-M method to solve the following LP Problem.   (6)

$$MaxZ = 6x_1 - 3x_2 + 2x_3 \quad \text{Subject to}$$

$$2x_1 + x_2 + x_3 \leq 16$$
$$3x_1 + 2x_2 + x_3 \leq 18$$
$$x_2 - 2x_3 \geq 8$$
$$x_1, x, x_3 \geq 0.$$

Module II

13   Apply the principle of duality to solve the following LPP.   (6)

$$MinimizeZ = 3x_1 + 5x_2 \quad \text{Subject to}$$

$$2x_1 + 8x_2 \geq 40$$
$$3x_1 + 4x_2 \geq 50$$
$$x_1, x \geq 0.$$

OR

14   Using Revised Simplex method solve   (6)

$$MaxZ = x_1 + 2x_2 \quad \text{Subject to}$$

$$x_1 + x_2 \leq 3$$
$$x_1 + 2x_2 \leq 5$$
$$3x_1 + x_2 \leq 6$$
$$x_1, x \geq 0.$$

Module III

15   A company has five machines to do five jobs. Each job can be assigned to one and   (6)
only one machine. The cost of each job in each machine is given in the following
table

	Machines				
Job	I	II	III	IV	V
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	15

What are job assignments which will minimize the cost?

OR

16   Solve the following transportation problem having three origins and four destinations.   (6)

	D1	D2	D3	D4	Resource
O1	2	2	2	1	3
O2	10	8	5	4	7
O3	7	6	6	8	5
Demand	4	3	4	4	

Module IV

17   A project schedule has the following characteristics.   (6)

Activity: 1-2   1-3   1-4   2-5   4-6   3-7   5-7   6-7   5-8   6-9   7-10   8-10   9-10

Time   : 10   8   9   8   7   16   7   7   6   5   12   13   15

(i) Construct the network

(ii) Find the critical path and the project duration.

(iii) Calculate the three floats for each activity.

OR

18   The following table lists the jobs of a network along with their time estimates.   (6)

Job$(i-j)$:	1-2	1-3	2-3	1-4	3-5	4-5	4-6	5-7	5-6	6-8	7-8
t_0 :	4	5	8	2	4	7	8	4	3	5	6
t_m :	5	7	10	4	7	8	12	6	5	8	9
t_p :	6	9	12	6	10	15	16	8	7	11	12

(i)   Draw the project network

(ii)   Find the expected duration and variance of each activity

(iii)   Calculate the variance of the project length

(iv)   Find the probability that the project is completed in 39 days.

(For standard normal Z = 1.1547, area under the standard normal curve from −∞ to Z is 0.8749).

Module V

19   A self-service store employs one cashier at counter. Nine customers arrive on an   (6) average every 5 minute while the cashier can serve 10 customers in 5 minute. Assuming poisson distribution for arrival rate and exponential distribution for service rate. Find

(i)   Average number of customers in the system

(ii)   Average number of customers in the queue

(iii)   Average time a customer spend in the system

(iv)   Average time a customer waits for being served.

OR

20   In a railway marshalling yard goods train arrived at the rate of 30 trains per day.   (6) Assuming that inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average of 36 minutes. If the capacity of the yard is 9 trains. Calculate

(i)   Probability that the yard is empty

(ii)   Average queue length.

****