Reg. No.											

Question Paper Code	11670

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

Fourth Semester

Computer Science and Business Systems

20BSMA405 - OPERATIONS RESEARCH WITH LABORATORY

(Regulations 2020)

(Usage of Statistical Tables permitted)

Duration: 3 Hours   Max. Marks: 100

PART - A (10 × 2 = 20 Marks)
Answer ALL Questions

Marks,
K-Level,CO

1. Express the following L.P.P in standard form:

   Max $z = 3x_1 + 4x_2$

   subject to $x_1 + x_2 \leq 450$

   $2x_1 + x_2 \leq 600$

   where $x_1, x_2 \geq 0$ 2,K2,CO1

2. Explain the significance of the following variables with examples: 2,K2,CO1
   (i) Slack variables (ii) Surplus variables

3. Construct the dual of the problem   2,K2,CO2

   Max $z = 3x_1 + 10x_2 + 2x_3$

   subject to $2x_1 + 3x_2 + 2x_3 \leq 7$

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

   where $x_1, x_2, x_3 \geq 0$

4. Explain how maximization problems are solved in the assignment model.   2,K2,CO3

5. What do you mean by unbalanced transportation problem? How would you   2,K2,CO3
   convert the unbalanced problem into a balanced one?

6. Explain the following terms in inventory management: (i) Holding cost   2,K2,CO4
   (ii) Ordering cost.

7. Discuss the terms: balking, reneging, and jockeying in Queuing theory.   2,K2,CO5

8. State the little's formula in Queuing theory.   2,K1,CO5

9. Define critical path.   2,K1,CO6

10. Explain the terms: (i) optimistic time (ii) most likely time (iii) pessimistic   2,K2,CO6
    time in PERT networks

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **11670**

PART - B (5 × 16 = 80 Marks)
Answer ALL Questions

11. a) (i) Use the graphical method to solve the following LP problem.   *16,K3,CO1*
Maximize $Z = 2x_1 + x_2$
Subject to the Constraints
$x_1 + 2x_2 \le 10$
$x_1 + x_2 \le 6$
$x_1 - x_2 \le 2$
$x_1 - 2x_2 \ge 1$
and $x_1, x_2 \ge 0$

OR

b) Solve using the Big M method: *16,K3,CO1*
Minimize $Z = 2x_1 + 9x_2 + x_3$
subject to
$x_1 + 4x_2 + 2x_3 \ge 5$
$3x_1 + x_2 + 2x_3 \ge 4$
$x_1, x_2, x_3 \ge 0$

12. a) A marketing manager has five salesmen and five sales districts.   *16,K3,CO3*
Considering the capabilities of the salesmen and the nature of districts,
the marketing manager estimates that the sales per month (in hundred
rupees) for each salesman in each district would be as follows:

		Districts				
		A	B	C	D	E
	1	32	38	40	28	40
Salesmen	2	40	24	28	21	36
	3	41	27	33	30	37
	4	22	38	41	36	36
	5	29	33	40	35	39

Find the assignment of salesmen to districts that will result in
maximum sales.

OR

b) Solve the following transportation problem to minimize the total cost   *16,K3,CO3*
of transportation:

		Destination				
		1	2	3	4	Supply
Origin	1	14	56	48	27	70
	2	82	35	21	81	47
	3	99	31	71	63	93
Demand		70	35	45	60	

13. a) Use dual simplex method to

       Minimize $z = 2x_1 + x_2$

       Subject to $3x_1 + x_2 \geq 3$

       $4x_1 + 3x_2 \geq 6$

       $x_1 + 2x_2 \leq 3$

       $x_1 , x_2 \geq 0$

OR

b) Obtain the dual of the following L.P.P. Find the solution of the primal problem by solving its dual.

       Max $z = 30x_1 + 23x_2 + 29x_3$

       subject to $6x_1 + 5x_2 + 3x_3 \leq 26$

       $4x_1 + 2x_2 + 5x_3 \leq 7$

       $x_1 , x_2 , x_3 \geq 0$

14. a) Arrivals at a telephone booth are considered to be Poisson, with an average of time of 9 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean 3 minutes. Then,

    (i)   What is the probability that a person arriving at the booth will have to wait in the queue?

    (ii)   Find the average number of persons waiting in the system.

    (iii) Estimate the fraction of a day that the phone will be idle.

    (iv) What is the average length of the queue that forms from time to time?

    (v)   What is the probability that the waiting time in the system is more than 10 minutes?

OR

b) A bank has two tellers working on a savings account. The first teller handles withdrawals only while the second teller handles deposits only. It has been found that the service time distribution for deposits and withdrawals both is exponential with mean service time 3 minutes per customer. Depositors are found to arrive in a Poisson fashion throughout the day with mean arrival rate 16 per hour. Withdrawers also arrive in a Poisson fashion with mean arrival rate 14 per hour.

    (i) What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits?

    (ii) What would be the effect if this could only be accomplished by increasing the service time to 3.5 minutes?

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

15. a) A project schedule has the following characteristics:

Activity	1 – 2	1 – 3	2 – 4	3 – 4	3 – 5	4 – 9
Time (Weeks)	4	1	1	1	6	5

Activity	5 – 6	5 – 7	6 – 8	7 – 8	8 – 10	9 – 10
Time (Weeks)	4	8	1	2	5	7

Construct the network and find the critical path. Also compute total, free and independent floats.

OR

b) The time estimates (in weeks) for the activities of a PERT network are given below:

Activity	t_o	t_m	t_p
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

1) Draw the project network and identify all the paths through it.
2) Determine the expected project length
3) Calculate standard deviation and variance of project length
4) What is the probability that the project will be completed at least 4 weeks earlier than expected time

If the project due date is 19 weeks, what is the probability of not meeting the due date.