**A** **Reg. No. :** | | | | | | | | | | |

## Question Paper Code: 55704

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2022

Fifth Semester

Mechanical Engineering

15UME504 - OPERATIONS RESEARCH

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Linear programming problem involving only two variable can be solved by CO1- R

   (a) Big M method (b) Simplex method

   (c) Graphical method (d) None of the these

2. The linear function of the variables which is to be maximize or minimize is called CO1- R

   (a) Constraints (b) Objective function (c) Decision variable (d) None of them

3. MODI method is also called as CO2- R

   (a) North west comer rule (b) Least cost method

   (c) U-V method (d) Stepping stone method

4. Johnson's algorithm is used to find for _____ problem. CO2- R

   (a) Transportation (b) Travelling salesman (c) Sequencing (d) Assignment

5. The critical path of a network is the CO3- R

   (a) Path with the fewest activities (b) Shortest time path through the network

   (c) Longest time path through the network (d) Path with the most activities

6. In a CPM / PERT network a dummy activity is necessary when CO3- R

(a) Two activities have the same starting node

(b) Two activities have the same ending node

(c) A node does not actually connect to another nod

(d) When two activities share the same starting and ending node

7. One of the important basic objective of inventory management is CO4- R

(a) To calculate EOQ for all materials in the organization

(b) To go in person to the market and purchase the materials

(c) To employ the available capital efficiently so as to yield maximum results

(d) Once materials are issued to the departments, personally check how they are used

8. Group replacement policy is most suitable for CO4- R

(a) Trucks (b) Infant machines (c) Street light bulbs (d) New cars

9. A mixed strategy game can be solved by CO5- R

(a) Algebraic method (b) Matrix method

(c) Graphical Number of players (d) All of the above

10. This department is responsible for the development of queuing theory CO5- R

(a) Railway station (b) Municipal office

(c) Telephone department (d) Health department

PART – B (5 x 2= 10 Marks)

11. What do you mean by L.P.P. CO1-U

12. Define the problem of sequencing. CO2-U

13. What are the applications of PERT / CPM techniques. CO3-U

14. Define Mortality theorem. CO4-U

15. Define competitive game. CO5-U

PART – C (5 x 16= 80 Marks)

16. (a) Using graphical method, solve the following L.P.P. CO1- App (16)

Maximize $Z = 2x_1 + 3x_2$

Subject to $x_1 - x_2 \leq 2$

$x_1 + x_2 \geq 4$ and $x_1, x_2 \geq 0$.

Or

(b) Use Big – M method to solve CO1- App (16)

Minimize $Z = 4x_1 + 3x_2$

Subject to $2x_1 + x_2 \geq 10$

$-3x_1 + 2x_2 \leq 6$

$x_1 + x_2 \geq 6$

and $x_1, x_2 \geq 0$.

17. (a) Solve the transportation problem CO2- App (16)

| | To | | | | Supply |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 6 |
| | 4 | 3 | 2 | 0 | 8 |
| | 0 | 2 | 2 | 1 | 10 |
| Demand | 4 | 6 | 8 | 6 | |

Or

(b) A batch of 4 jobs can be assigned to 5 different machines. The set up time (in hours) for each job on various machines is given below. CO2- App (16)

| Job | Machine 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | 10 | 11 | 4 | 2 | 8 |
| | 7 | 11 | 10 | 14 | 12 |
| | 5 | 6 | 9 | 12 | 14 |
| | 13 | 15 | 11 | 10 | 7 |

Find an optimal assignment of jobs to machines which will minimize the total set up time.

18. (a) Consider the details of a distance network as shown in below CO3 Ana (16)

(i) Construct a project network

(ii) Determine the maximal flow from node 0 to 5

| AVC (i-j) | Flow | |
|---|---|---|
| | fij | fji |
| 0-1 | 11 | - |
| 0-2 | 12 | - |
| 1-3 | 12 | - |
| 2-1 | 1 | - |
| 2-4 | 11 | - |
| 3-4 | 7 | - |
| 3-5 | 19 | - |
| 4-5 | 4 | - |

Or

(b) A project has the following time schedule. CO3- Ana (16)

| Activity | Time in month | Activity | Time in month |
|---|---|---|---|
| 1 – 2 | 2 | 3 – 7 | 5 |
| 1 – 3 | 2 | 4 - 6 | 3 |
| 1 – 4 | 1 | 5 – 8 | 1 |
| 2 – 5 | 4 | 6- 9 | 5 |
| 3 – 6 | 8 | 7 – 8 | 4 |
| | | 8 – 9 | 3 |

Construct PERT network and compute

(i) Total float for each activity.

(ii) Critical path and its duration.

Also find the minimum number of cranes the project must have for its activities 2 – 5, 3 – 7 and 8 – 9 without delaying the project. Then, is there any change required in PERT network. If so, indicate the name.

19. (a) A factory needs 36000units annually of a component that cost Rs 2 per unit. Cost of each order placing is Rs 25 and inventory carrying cost is Rs 10 per year. CO4- App (16)

(i) Find the economic lot size and the total inventory cost.

(ii) What is the time between placing of order.

(iii) The supplier offers 2% discount if a single order is placed. Should the company accept it.

Or

(b) A machine owner has three machines of purchase price Rs 6000 each and cost per year of maintaining each machine is same. Two of these machines are two-year-old and the third is one-year-old. He is considering a new machine of purchase price Rs 8000 with 50% more capacity than one of the old ones. The estimates of maintaining cost and resale price for new machine are as given below. CO4 Ana (16)

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Maintenance cost(Rs) | 1200 | 1500 | 1800 | 2400 | 3100 | 4000 | 5000 | 6100 |
| Resale price (Rs) | 4000 | 2000 | 1000 | 500 | 300 | 300 | 300 | 300 |

Assuming that the loss of flexibility due to fewer machines is of no importance, and he continues to have sufficient work for three of the old machines, what should his policy be.

20. (a) Sunil Medicals is manned by three salesmen. Any salesman can provide desired service to any customers. The customers arrive at the counter according to Poisson distribution at an average rate of 30 per hour. The service time is exponential with a mean rate of 3 min. CO5-App (16)

(i) What fraction of time are all three attendants busy.

(ii) What is the mean number of customers waiting to be attended.

(iii) What average time does a customer spend at the shop.

(iv) What is the probability that a customer has to wait.

Or

(b) (i) Explain the terms in relation to game theory. CO5-App (16)

(a) Mixed strategy

(b) Saddle point

(c) Dominance

(ii) Solve the following games.

$$\begin{array}{cc} & \begin{matrix} & B \\ & 1 \quad 2 \quad 3 \end{matrix} \\ \begin{matrix} A \\ \\ \end{matrix} & \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} \begin{pmatrix} 1 & 7 & 2 \\ 6 & 2 & 7 \\ 5 & 1 & 6 \end{pmatrix} \end{array}$$