ஸ்ரீ-ல-ஸ்ரீ காசிவாசி சுவாமிநாத சுவாமிகள் கலைக் கல்லூரி
திருப்பனந்தாள் – 612504

S.K.S.S ARTS COLLEGE, THIRUPPANANDAL - 612504

QUESTION BANK

Title of the Paper

OPERATIONS RESEARCH

COURSE – III B.Sc., Maths

Prepared by

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MAJOR BASED ELECTIVE I (A)

OPERATIONS RESEARCH

Objectives:

1. To introduce the various techniques of Operations Research.
2. To make the students solve real life problems in Business and Management

UNIT I

Linear programming problem - Mathematical formulation – Illustrations on Mathematical formulation on Linear Programming Problems – Graphical solution method - some exceptional cases - Canonical and standard forms of Linear Programming Problem - Simplex method.

UNIT II

Use of Artificial Variables (Big M method - Two phase method) – Duality in Linear Programming - General primal-dual pair - Formulating a Dual problem - Primal-dual pair in matrix form -Dual simplex method.

UNIT III

Transportation problem - LP formulation of the TP - Solution of a TP - Finding an initial basic feasible solution (NWCM - LCM -VAM) – Degeneracy in TP - Transportation Algorithm (MODI Method) - Assignment problem - Solution methods of assignment problem – special cases in assignment problem.

UNIT IV

Queuing theory - Queuing system - Classification of Queuing models - Poisson Queuing systems Model I (M/M/1)(∞/FIFO) only - Games and Strategies – Two person zero sum - Some basic terms - the maximin-minimax principle -Games without saddle points-Mixed strategies - graphic solution 2xn and mx2 games.

UNIT V

PERT and CPM – Basic components – logical sequencing - Rules of network construction- Critical path analysis - Probability considerations in PERT.

Book for Study:

Kanti Swarup, P.K. Gupta and ManMohan, Operations Research, 13th edition, Sultan Chand and Sons, 2007.

Unit 1: Chapter 2 Sec 2.1 to 2.4, Chapter 3 Sec 3.1 to 3.5, Chapter 4 Sec 4.1 , 4.3

Unit 2: Chapter 4 Sec 4.4, Chapter 5 Sec 5.1 to 5.4, 5.9

Unit 3: Chapter 10 Sec 10.1, 10.2, 10.8, 10.9, 10.12, 10.13, Chapter 11 Sec 11.1 to 11.4

Unit 4: Chapter 21 Sec 21.1, 21.2, 21.7 to 21.9, Chapter 17 Sec 17.1 to 17.6

Unit 5: Chapter 25 Sec 25.1 to 25.4, 25.6, 25.7

Book for Reference:

1. Sundaresan.V, Ganapathy Subramanian. K.S. and Ganesan.K, Resource Management Techniques, A.R. Publications, 2002.

2. Taha H.A., Operations Research: An introduction, 7th edition, Pearson Prentice Hall, 2002.

UNIT - I

CHOOSE THE CORRECT ANSWERS

1. Operations research, which is a very powerful tool for …………
   - a) Research
   - b) Decision-Making
   - c) Operations
   - d) None of the above
2. Who coined the term operation research ……….
   - a) J.F.Mc Closkey
   - b) F.N.Trefethen
   - c) P.F.Adams
   - d) Both A and B
3. The term operations research was coined in year ……….
   - a) 1950
   - b) 1940
   - c) 1978
   - d) 1960
4. Operations research has the characteristic the it is done by a term of ………
   - a) Scientists
   - b) Mathematicians
   - c) Academics
   - d) All of the above
5. A LPP involving two decision variables can be conveniently solved by ……….
   - a) Graphical
   - b) Simple method
   - c) Ordinary method
   - d) None
6. Operations research is a ………
   - a) Science
   - b) Art
   - c) Mathematics
   - d) Both A and B

7. The objective function, the set of constraints and the non-negative constraints together form
   a) LPP
   b) TP
   c) Game theory
   d) None
8. In a graphical method, the solution space is called
   a) Non-convex region
   b) Convex region
   c) Data inadequate
   d) None
9. Simplex method is an
   a) Iterative method
   b) Ordinary method
   c) Simple method
   d) None
10. A basic solution which also satisfies the condition in which all basic variables are non- negative is called ………
   a) Basic feasible solution.
   b) Feasible solution.
   c) Optimal solution.
   d) None of the above.

ANSWERS

1) b 2) d 3) b 4) a 5) a 6) d 7) a 8) b 9) a 10) a

TWO MARK QUESTIONS

11. What is OR?
12. Define some significant feature of OR.
13. What are the stages in OR?
14. What are the limitations of OR?
15. Define application of OR.
16. Define objective function.
17. Define feasible and infeasible solution.
18. What is slack variable?

19. How determine the pivot element.

20. Define optimal solution.

FIVE MARK QUESTIONS

21. Explain linear programming problem.

22. What are the uses of operations research?

23. Explain Generalization of linear programming problem.

24. Explain mathematical formulation of LPP.

25. Explain standard form of LPP.

26. Explain graphical method.

27. A farmer has 1000 acres of land on which he can grow corn, wheat, soya beans. Each acres of corn cost Rs 100 for preparation remains 7 man- days of work cost Rs 120 to prepare, requires 10- Man- days of work and yields a profit of Rs 40. Acres of soybeans cost Rs 70 to prepare, require 8 men per day of work and yields a profit of Rs 20. If the Farman has Rs 1, 00,000 for preparation and can count on 80,000 man pre days of work, formulate the mathematical model

28. A dietician wishes to mix two types of food in such a way that the vitamin contains of the mixture contains at least 8 units of vitamin A and 10 units of vitamin B. Food one contains two units per Kg of vitamin A and 1 units per Kg of vitamin B and the food two contains 1 unit per kg of vitamin B. It cast Rs 5 per kg to purchase food one and Rs 8 per kg to purchase food two form the mathematical model.

29. Solve the graphical method

$max\ z = 6x_1 + x_2$

Subject to the constrains

$2x_1 + x_2 \geq 3$

$x_2 - x_2 \geq 0$

$x_1, x_2 \geq 0.$

30. Solve the equation by using Simplex method

$max\ z = 4x_1 + 7x_2$

Subject to the constrains

$4x_1 + 3x_2 \leq 12$

$3x_1 + 4x_2 \leq 12$

$x_1 , x_2 \geq 0.$

TEN MARK QUESTIONS

31. Explain canonical and standard forms of LPP.

32. A machine producing either product A or B. A produce two units of chemical and 1 unit of compound & B can produce one unit of chemical and 2 units of compound. Availabilities 800 units of chemicals and 1000 units of compound their profits are Rs 30 per units of A Rs 20 per units of B. Draw the suitable diagram and find the maximum profit.

33. Explain algorithm of Simplex method.

34. Draw the graph & find the optimum solution

$$maxz = 3x_1 + 2x_2$$

Subject to the constrains

$$x_1 - x_2 \leq 1$$

$$x_1 + x_2 \geq 3$$

$$x_1, x_2 \geq 0.$$

35. Using graphical method & find the optimum solution.

$$maxz = 5x + 7y$$

Subject to the constrains

$$12x + 12y \leq 840$$

$$3x + 6y \leq 300$$

$$8x + 4y \leq 480$$

$$x, y \geq 0$$

36. Draw the graph and find the optimum solution

$$maxz = x_1 + x_2$$

Subject to the constrains

$$x_1 + x_2 \leq 1$$

$$-3x_1 + x_2 \geq 3$$

$$x_1, x_2 \geq 0$$

37. Find the optimum solution by using Simplex method

$$minz = -x_1 + 2x_2$$

Subject to the constrains

$$-x_1 + 3x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1, x_2 \geq 0$$

38. Find the optimum solution by using Simplex method

$$max z = 5x_1 + 3x_2$$

Subject to the constrains

$$x_1 + x_2 \leq 2$$
$$5x_1 + 2x_2 \leq 10$$
$$3x_1 + 8x_2 \leq 1$$
$$x_1, x_2 \geq 0$$

39. Find the optimum solution by using Simplex method

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

Subject to the constrains

$$x_1 + 2x_2 + x_3 \leq 4$$
$$x_1 + 2x_2 + 2x_3 \leq 5$$
$$x_1 - x_2 \leq 1$$
$$x_1, x_2, x_3 \geq 0$$

40. Find the optimum solution by using Simplex method

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

Subject to the constrains

$$2x_1 + x_2 - x_3 \leq 2$$
$$-2x_1 - x_2 + 5x_3 \leq 6$$
$$4x_1 + x_2 + x_3 \leq 6$$
$$x_1, x_2, x_3 \geq 0$$

UNIT- II

CHOOSE THE CORRECT ANSWER

1. Pivotal element also called
   a) Leading element
   b) Element
   c) common element
   d) None
2. Dual of the dual is
   a) data inadequate
   b) dual

c) primal

d) none

3. If the primal problem has a finite optimum solution. Then its dual problem also have a
   a) finite optimum solution
   b) infinite optimum solution
   c) optimal solution
   d) none
4. A cost of each artificial variable is
   a) +1
   b) -1
   c) 0
   d) -5
5. If the primal problem has an unbounded solution. Then dual has
   a) feasible solution
   b) no feasible solution
   c) data inadequate
   d) none
6. Dual simplex method is only for some
   a) $X_{Bi} < 0$
   b) $X_{Bi} > 0$
   c) $X_{Bi} = 0$
   d) none
7. A necessary and sufficient condition for a basic feasible solution to a LPP to be an optimum is that $z_j - c_j \geq 0$ for all j

   The above statement is
   a) data inadequate
   b) incorrect
   c) correct
   d) none
8. $minz = 3x_1 + 2x_2$

   stc, $x_1 - x_2 \geq 3$

   $2x_1 - 3x_2 \geq 4$

To make this problem to a standard form, we can subtract,

a) slack variable
b) surplus variable
c) decision variable
d) none

9. If dual has an unbounded solution , primal has
   a) an unbounded solution
   b) an infeasible solution
   c) a feasible solution
   d) None
10. Dual simplex method is applicable to these LPP that start with
   a) an infeasible solution
   b) an infeasible but optimum solution
   c) a feasible solution
   d) a feasible and optimum solution

ANSWERS

1)a 2)c 3)a 4)a 5)b 6)a 7)c 8)b 9)b 10)b

TWO MARK QUESTIONS

11. What is surplus variable?
12. Define dual of an LPP.
13. Define primal of an LPP.
14. Define penalty method.
15. Define two phase method.
16. What is the purpose of introducing artificial variable in penalty method?
17. How to get dual solution from primal.
18. Importance of duality in LPP.
19. What are the characteristics of primal and dual problem?
20. Find the dual of the following problem

$$maxz = x_1 + 2x_2$$

Subject to the constrains

$$x_1 - x_2 \leq 3$$

$$2x_1 + x_2 \geq 4$$

$$x_1, x_2 \geq 0$$

FIVE MARK QUESTIONS

21. Write short notes on dual of a programming model.
22. Difference between dual and primal problem.
23. To solve LPP by using big M- method.

$$maxz = x_1 + 2x_2$$

Subject to the constrains

$$x_1 - x_2 \geq 3$$

$$2x_1 + x_2 \leq 10$$

$$x_1, x_2 \geq 0$$

24. Solve LPP by using big- M-method

$$maxz = 2x_1 + 3x_2$$

Subject to the constrains

$$x_1 + 2x_2 \leq 3$$

$$x_1 + x_2 = 10$$

$$x_1, x_2 \geq 0$$

25. Solve LPP by using big-M-method

$$maxz = 3x_1 + 4x_2$$

Subject to the constrains

$$2x_1 + x_2 \leq 2$$

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

$$x_1, x_2 \geq 0$$

26. Solve the equation by using two phase method

$$maxz = 3x_1 + 2x_2$$

Subject to the constrains

$$2x_1 + x_2 \leq 2$$

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

$$x_1, x_2 \geq 0$$

27. Solve the equation by using two phase method

$$maxz = 3x_1 - x_2$$

Subject to the constrains

$$2x_1 + x_2 \geq 2$$

$$x_1 + 3x_2 \leq 3$$

$$3x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

28. Solve LPP by using two phase method

$$minz = 12x_1 + 20x_2$$

Subject to the constrains

$$6x_1 + 8x_2 \geq 100$$

$$7x_1 + 12x_2 \geq 120$$

$$x_1, x_2 \geq 0$$

29. Find the dual of the following problem and then obtain the solution.

$$minz = 20x_1 + 10x_2$$

Subject to the constrains

$$x_1 + x_2 \geq 10$$

$$3x_1 + 2x_2 \geq 24$$

$$x_1, x_2 \geq 0$$

30. Write the primal of the following dual.

$$minz = 10x_1 + 8x_2$$

Subject to the constrains

$$x_1 + x_2 \geq 5$$

$$2x_1 - x_2 \geq 12$$

$x_1 \geq 0, x_2$ is unrestricted.

TEN MARK QUESTIONS

31. Write the algorithm of two phase method.
32. Write the algorithm of Big M –method.
33. Write the algorithm of dual simplex method.
34. Solve LPP by using big-M-method.

$$minz = 4x_1 + 3x_2$$

Subject to the constrains

$$2x_1 + x_2 \geq 10$$

$$-3x_1 + 2x_2 \leq 6$$

$$x_1 + x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

35. Solve LPP by using big-M-method

$$maxz = 2x_1 + x_2 + 3x_3$$

Subject to the constrains

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

$$2x_1 + 3x_2 + 4x_3 = 12$$

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

36. Solve the equation by using two phase method

$$minz = 2x_1 + x_2$$

Subject to the constrains

$$3x_1 + x_2 = 10$$

$$x_1 + 2x_2 \leq 6$$

$$4x_1 + 3x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

37. Solve the equation by using two phase method.

$$maxz = 5x_1 + 8x_2$$

Subject to the constrains

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

$$x_1 + 4x_2 \geq 4$$

$$x_1 + x_2 \leq 5$$

$$x_1, x_2 \geq 0$$

38. Solve the equation by using dual simplex method.

$$maxz = x_1 + 2x_2 + x_3$$

Subject to the constrains

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

$$2x_1 + 2x_2 - 5x_3 \geq 6$$

$$4x_1 + x_2 + x_3 \geq 6$$

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

39. Solve the LPP by Dual simplex method

$$\min z = 3x_1 + 2x_2$$

Subject to the constrains

$$x_1 + x_2 \geq 1$$

$$x_1 + x_2 \leq 7$$

$$x_1 + 2x_2 \leq 10$$

$$x_2 \leq 3$$

$x_1, x_2 \geq 0$

40. Construct the dual of the following problem

$$\max z = 6x_1 + 2x_2$$

Subject to the constrains

$$3x_1 + 4x_2 \leq 40$$
$$5x_1 + 2x_2 \leq 30$$
$$6x_1 - 3x_2 \leq 15$$
$$x_2 \leq 20$$
$$x_1, x_2 \geq 0$$

UNIT - III

CHOOSE THE CORRECT ANSWER

1. In a TP the most accurate method is
   a) North West corner rule
   b) Least cost method
   c) Vogel's approximation method
   d) Column or row method
2. Assignment problem is a particular case of
   a) Simplex problem
   b) Sequencing problem
   c) Transportation problem
   d) None of the above
3. ………. Is one of the fundamental combinatorial optimization problems?
   a) Assignment problem
   b) Transportation problem
   c) Optimization problem
   d) None of the above
4. $\sum a_i = \sum b_j$. This problem is called
   a) Balanced TP
   b) Unbalanced TP
   c) Data inadequate
   d) All of the above
5. The method uses for solving an assignment problem is called……..

a) Reduced matrix method.

b) Modi method

c) Hungarian method

d) None of the above

6. The purpose of a dummy row or column in an assignment problem is to ………

   a) Obtain balance between total activities & total resources

   b) Prevent a solution from becoming degenerate

   c) Provide a means of representing a dummy problem

   d) None of the above.

7. The solution to a TP with m-source and n-destinations is feasible, if the number of allocations are

   a) $m + n - 1$

   b) $m + n + 1$

   c) $m + n$

   d) mn

8. To proceed with the modi algorithm for solving an assignment problem, the number of dummy allocations need to be added are ……

   a) n

   b) 2n

   c) n-1

   d) 2n-1

9. The Hungarian method for solving an assignment can also be used to solve ……..

   a) A transportation problem.

   b) A travelling salesman problem.

   c) A LP problem

   d) Both A and B

10. An optimal solution of an assignment problem can be obtained only if …….

   a) Each row & column has only one zero element.

   b) Each row & column has at least one zero element.

   c) The data is arrangement in a square matrix.

   d) None of the above

ANSWERS

1) c 2) c 3) a 4) a 5) c 6) a 7) a 8) c 9) b 10) d

TWO MARK QUESTIONS

11. What is Transportation problem?
12. Define balanced TP.
13. Define unbalanced TP.
14. Define feasible solution.
15. Define basic feasible solution.
16. Define Optimum solution.
17. What is degeneracy in TP?
18. What is non-degenerate basic feasible solution to a TP?
19. What do you understand by ‘rim conditions’ in a TP?
20. Define basic and non-basic cells.

FIVE MARK QUESTIONS

21. Write the algorithm of North West corner method.
22. Write the algorithm of row minima method.
23. Write the algorithm of column minima method.
24. Write the algorithm of least cost method.
25. What are the objectives of travelling salesman problem?
26. Determine an IBFS to the following problem by using NWCM.

6	4	8	4	9	6	4
6	7	13	6	8	12	5
3	9	4	5	9	13	3
10	7	11	6	11	10	9
4	4	5	3	2	3	

27. Determine an IBFS to the following problem by using Row minima method.

50	30	220	1
90	45	170	3
250	200	50	4
4	2	2	

28. Determine an IBFS from the following problem by using Column minima method.

6	4	1	5	14
8	9	2	7	16
4	3	6	2	5
6	10	15	4	

29. Determine an IBFS by using least cost method.

1	2	3	4	6
4	3	2	0	8
0	2	2	1	10
4	6	8	6	

30. Determine an IBFS by using Column minima method.

50	30	220	1
90	45	170	3
250	200	50	4
4	2	2	

TEN MARK QUESTIONS

31. Write the algorithm of Vogel's Approximation method.
32. Describe the Hungarian algorithm for solving an assignment problem.
33. Find the minimum assignment cost by using assignment problem.

120	100	80	90
80	90	110	70
120	140	120	100
90	90	80	90

34. Find the minimum assignment cost from the following data by using assignment problem.

62	78	50	101	82
71	84	61	73	59
87	92	111	71	81
48	64	87	77	80

35. Determine an IBFS by using VAM method.

11	13	17	14	250
14	18	14	10	300
21	24	13	10	400
200	225	275	250	

36. Solve the Modi method by using VAM method.

6	4	1	5	14
8	9	2	7	16
4	8	6	2	5
6	10	15	4	

37. Determine an IBFS of the Modi method by using VAM method.

6	8	4	14
4	9	8	12
1	2	6	5
6	10	15	

38. Find the minimum assignment cost from the following assignment problem.

18	26	17	11
13	28	14	26
38	19	18	15
19	26	24	10

39. Find out maximum profit to the assignment problem.

33	21	35	23
29	33	37	31
31	31	33	29
27	25	35	37

40. Determine IBFS of the Modi method by using VAM method.

2	7	4	5
3	3	1	8
5	4	7	7
1	6	2	14
7	9	18	

UNIT – IV

CHOOSE THE CORRECT ANSWER

1. Relation between average queue length and average waiting time is
    a) Little's formula
    b) Stirling's formula
    c) Erlong's formula
    d) None of these
2. For M/M/1 model the probability that there is no customer in the system is
    a) $1 - \rho$
    b) $1/\rho$
    c) ρ
    d) None of these
3. For M/M/1 model the expected number of busy servers are equal to ________
    a) Traffic intensity ρ
    b) Arrival rate λ
    c) Service rate μ
    d) None of these
4. For M/M/1 system, the expected waiting time in the queue is
    a) $\frac{\lambda}{\mu}$
    b) $\frac{\lambda}{\mu(\mu-\lambda)}$
    c) $\frac{\lambda}{\mu-\lambda}$
    d) None of these
5. For M/M/1 system, the expected queuing length is
    a) $\frac{\lambda^2}{\mu}$
    b) $\frac{\lambda^2}{\mu(\mu-\lambda)}$
    c) $\frac{\lambda}{\mu-\lambda}$
    d) None of these
6. Dominance property is in
    a) Queuing theory
    b) Game theory

c) Decision theory
d) None

7. A game is said to have a saddle point if
   a) Maximin value = minimax value
   b) Maximin value >minimax value
   c) Maximin value <minimax value
   d) Maximin value ≥ minimax value
8. Selecting the maximum from among row minimums is
   a) Minimax principle
   b) Maximin principle
   c) Hungarian method
   d) Oddments
9. Selecting the minimum from among column maximums is
   a) Minimax principle
   b) Maximin principle
   c) Hungarian method
   d) Oddments
10. If the value of the game is “zero” the game is said to be
   a) Fair
   b) Not fair
   c) Indeterminate
   d) Not fair but strictly determinable

ANSWERS:

1)a 2)a 3)a 4)b 5)b 6)b 7)a 8)b 9)a 10)a

TWO MARK QUESTIONS

11. Define queue.
12. What is average queue length?
13. What is average length of non-empty queue?
14. What is average number of customer in the system?
15. Expand M/M/1.
16. What is game theory?
17. What are pure strategies?
18. What are mixed strategies?
19. What is two person zero sum game?
20. Define saddle point.

FIVE MARK QUESTIONS

21. Explain Queuing theory.

22. Explain M/M/1 model.
23. If arrival rate is 20 customers/week and service rate is 50 customers/week then find the expected number of busy servers for M/M/1 queuing system.
24. If arrival rate is 15 customers per minute and service rate is 30 customers per minute, then for M/M/1 queuing system, find its traffic intensity.
25. For M/M/1 queuing system if arrival rate is 10 customers per day and service rate is 30 customers per day then find the expected number of customers in the queue on a certain day.
26. Explain any five terminologies related to game theory.
27. Explain the different types of games.
28. Explain Minimax and Maximin principle.
29. When is a game said to be a) Fair
    b) Not fair but strictly determinable
    c) Indeterminate
30. Solve the following game whose payoff matrix is given below

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{ccc} B_1 & B_2 & B_3 \end{array} \\ \begin{bmatrix} 1 & 3 & 1 \\ 0 & -4 & -3 \\ 1 & 5 & 1 \end{bmatrix} \end{array}$$

TEN MARK QUESTIONS

31. Explain operating characteristics of a queuing system.
32. In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that inter arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following:
    (i) the mean queue size(line length), and
    (ii) the probability that the queue size exceeds 10.
33. On an average 96 patients per 24-hour day require the service 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 Rs. 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 Rs. 10 per patient treated. How much would have to

be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ a patient.

34. A supermarket has a single cashier. During the peak hours, customers arrive at a rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 24 per hour. Calculate:
    (i) Probability that the cashier is idle.
    (ii) Average number of customers in the queuing system.
    (iii) Average time a customer spends in the system.
    (iv) Average time a customer spends in the queue waiting for service.
    (v) Queue size

35. The rate of arrival of customers at a public telephone booth follows Poisson distribution, with an average time of 10 minutes between one customer and the next. The distribution of a phone call is assumed to follow exponential distribution, with mean time of 3 minutes.
    (i) What is the probability that a person arriving at the booth will have to wait?
    (ii) What is the average length of the non-empty queues that form from time to time?

36. List out the advantages and limitation of Game theory.

37. Solve the game whose payoff matrix is given by

$$\begin{array}{cc} & player\ B \\ player\ A & \begin{bmatrix} 15 & 2 & 3 \\ 6 & 5 & 7 \\ -7 & 4 & 0 \end{bmatrix} \end{array}$$

38. Is the following two-person, zero sum game stable?
    Solve the game problem.

$$\begin{array}{cc} & player\ B \\ player\ A & \begin{bmatrix} 8 & 6 & 28 \\ 8 & 9 & 45 \\ 7 & 5 & 35 \end{bmatrix} \end{array}$$

39. Solve the following game using dominance property

$$\begin{array}{ccc} & & B \\ & & \begin{array}{cccc} \mathrm{I} & \mathrm{II} & \mathrm{III} & \mathrm{IV} \end{array} \\ A & \begin{array}{c} I \\ II \\ III \end{array} & \begin{bmatrix} -5 & 3 & 1 & 20 \\ 5 & 5 & 4 & 6 \\ -4 & -2 & 0 & -5 \end{bmatrix} \end{array}$$

40. Solve the following 2×3 game graphically

$$\begin{array}{cc} & \text{player } B \\ & \begin{array}{ccc} B_1 & B_2 & B_3 \end{array} \\ \text{player}A \begin{array}{c} A_1 \\ A_2 \end{array} & \begin{bmatrix} 1 & 3 & 11 \\ 8 & 5 & 2 \end{bmatrix} \end{array}$$

UNIT-V

CHOOSE THE CORRECT ANSWERS

1. PERT means
   a) Programmed evolution and review technique.
   b) Problem evolution and revision technique.
   c) Both A and B.
   d) None of the above.
2. CPM means.
   a) Critical path method.
   b) Criminal path method.
   c) Collective path method.
   d) None of the above.
3. PERT analysis is based on
   a) Optimistic time.
   b) Pessimistic time.
   c) Most likely time.
   d) All the above.
4. The particular task performance in CPM is Known
   a) Dummy
   b) Event
   c) Activity
   d) Contract
5. The Critical path
   a) Is a path that operates from the starting node to the end node.
   b) Is a mixture of all paths
   c) Is the longest path
   d) Is the shortest path
6. Completion of a CPM network diagram activity is commonly known.

a) Connector

b) Event

c) Node

d) All the above

7. PERT analysis is based on

a) Optimistic time

b) Pessimistic time

c) Most likely time

d) All the above

8. While scheduling a project by CPM

a) A project is divided into various activities.

b) Requires time for each activity is established.

c) A sequence of various activities is made according to their importance.

d) All the above.

9. Activities A, B and C are the immediate predecessors for Y activity. If the earliest finish for the three activities are 12,15 and 10, then the earliest start time for Y will be.

a) 10

b) 15

c) 12

d) Cannot be determined.

10. Activities P, Q and R instantly follow activity M, and their current start times are 12, 19 and 10. Therefore the latest finish time for activity M is

a) 11

b) 10

c) 18

d) Cannot be determined.

ANSWERS

1) a 2) a 3) d 4) c 5) c 6) d 7) d 8) d 9) b 10) a

TWO MARK QUESTIONS

11. Define Network.

12. Expand the following abbreviation: PERT and CPM
13. Define activity.
14. Define Dummy activity.
15. Define Looping.
16. Define Dangling.
17. Define total float.
18. Define free float.
19. Define Independent float.
20. Define Critical path.

FIVE MARK QUESTIONS

21. What are the rules for network constructions?
22. Write the procedure for PERT.
23. Explain three floats.
24. Explain three time estimates.
25. Distinguish between PERT and CPM.
26. Explain the applications of network techniques.
27. Construct the network diagram comprising activity B to Q the following constraints are satisfies

    B<E,F; C<G,L,E; G<H; L,H<I; L<M; H<J; H<N; I,J<P; P<Q.

28. Construct the arrow diagram with following activities.

    A<D,E; B,D<F; C<G; B<H; F,G<I.

29. Construct the arrow diagram with following activities.

    A<C,D,I; B<G,H; D<G,F: F<H,K; G,H<J; I,J,K<E.

30. Construct the network diagram from the following data and find project completion time.

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Durations	2	8	10	6	3	3	7	5	2	8

TEN MARK QUESTIONS

31. Construct the arrow diagram comprising activities A,B…. and L such that the following relationships are satisfied.

 i) A,B and C the first activities of the project can start simultaneously.

ii) A and B precede D.

iii) B precedes E,F and H.

iv) F and C precede G.

v) E and H precede I and J.

vi) C,D,F and J precede K.

vii) K precedes L.

viii) I,G and L are the terminal activities of the project.

32. Construct the network diagram having the following constraints.

A<D,E; B,D<F; C<G; B,G<H; F,G<I find also the minimum time one completion of project when the time of completion of each task has follows.

Task	A	B	C	D	E	F	G	H	I
Time	23	8	20	16	24	18	19	4	10

33. Construct the network diagram from the following data find project completion time.

Activity	a	b	C	d	e	f	g	h	i	j	k	l
Predecessor	Initial activity	a	A	b	b	c	c	c	d	g,h	e	i
Duration	10	9	7	6	12	6	8	8	4	11	5	7

34. Construct the network diagram from the following data find project completion time.

A<D; A<E; B<F; D<F; C<G; C<H; F<I; G<I.

A - 8, B – 10, C – 8, D – 10, E – 16, F – 17, G – 18, H – 14, I – 9.

35. Construct the network for the project whose activities and the three times estimate of these activities in weeks are given below.

i) Compute expected duration of each activity.

ii) Expected variance of each activity.

iii) Expected variance of the project length.

Activity	1-2	2-3	2-4	3-5	4-5	4-6	5-7	6-7	7-8	7-9	8-10	9-10
t_0	3	1	2	3	1	3	4	6	2	1	4	3
t_m	4	2	3	4	3	5	5	7	4	2	6	5
t_p	5	3	4	5	5	7	6	8	6	3	8	7

36. Find the probability for finishing the project in 24 weeks and 28 weeks.

Activity	1-2	1-3	2-3	2-4	2-5	3-4	4-7	5-6	5-7	6-7
t_0	3	1	6	0	2	3	6	1	2	4
t_m	4	2	8	0	5	5	9	1	5	8
t_p	5	3	10	0	8	7	12	1	8	12

37. Find the probability for melting the target time of 18 weeks.

Activity	1-2	2-3	2-4	3-5	4-6	5-6	5-7	6-7
t_0	3	3	2	4	4	0	3	2
t_m	3	6	4	6	6	0	4	5
t_p	3	9	6	8	8	0	5	8

38. From the following network find the critical path probability for finish in the project in 23 weeks.

Activity	1-2	1-3	3-4	3-5	4-5	5-6	2-6
t_0	8	6	5	8	3	5	9
t_m	9	7	5	10	4	6	12
t_p	10	9	5	11	6	8	15

39. Construct the network diagram and calculate the minimum time of project completion.

Activity	Predecessor activity	Duration
A	None	4
B	None	7
C	None	6
D	A,B	5
E	A,B	7
F	C,D,E	6
G	C,D,E	5

40. A project consists of eight activities with the following relevant information:

Activity	Immediate predecessor	Estimated duration(days)		
		Optimistic	Most likely	pessimistic
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D,E	3	6	15
H	F,G	1	2	3

(i) Draw the PERT network and find out the expected project completion time.

(ii) What duration will have 95% confidence for project completion?