

Reg. No. :

Code No. : 5549

Sub. Code : WKCE 12

M.Com. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2023.

First Semester

Commerce – Elective

OPERATIONS RESEARCH

(For those who joined in July 2023 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer:

1. A set of points is said to be _____ if the line joining any two of its points lies completely within the region.
(a) Concave (b) convex
(c) unbounded (d) infeasible

2. In the simplex method if in pivot column all the entries are negative or zero when choosing leaving variable then
- solution is degenerate
 - solution is infeasible
 - alternative optima
 - unbounded
3. In an l.p.p., the restrictions under which the objective function is to be optimised are called
- Constraints
 - objective function
 - decision variables
 - surplus variables
4. Degeneracy in a $m \times n$ transportation problem occurs when the number of occupied cells is less than
- $m + n$
 - $m - n$
 - $m + n - 1$
 - $m - n - 1$
5. MODI method associated with T.P, MODI stands for _____
- modal distribution
 - mode distribution
 - modified distribution
 - none of these

6. An assignment problem represents a T.P with all demands and supplies equal to _____
- 1
 - 2
 - 3
 - 0
7. If 5 jobs are processed through 2 machines, then the number of possible sequences is _____
- 280
 - 12240
 - 14400
 - 25
8. Games without saddle point require players to play _____ strategies.
- pure
 - no
 - mixed
 - one
9. The saddle point of $\begin{pmatrix} -4 & 3 \\ -3 & 7 \end{pmatrix}$ is _____
- zero
 - 12
 - does not exist
 - exist
10. The difference between purchase price and salvage value is called _____
- profit
 - selling price
 - principal
 - total depreciable amount

11. In PERT analysis, the variance of a job having optimistic time 5, most likely time 8 and pessimistic time 17 is _____
- (a) 12 (b) 9
(c) 20 (d) 40
12. The probability to complete a project in the expected time is _____
- (a) 0.5 (b) 1
(c) 0.2 (d) 0.8
13. Constant service time is special case of _____ service time.
- (a) kelvin (b) erlang
(c) wilson (d) bhat
14. Under Queue discipline SIRO refers to _____
- (a) service in random order
(b) service in ratio order
(c) sales in random order
(d) service in rank order
15. Chance nodes are represented by _____
- (a) disks (b) triangles
(c) squares (d) circles

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Solve the following L.P.P by the graphical method $Z = 3x_1 + 2x_2$.

Subject to the constraints $-2x_1 + x_2 \leq 1$,
 $x_1 \leq 2$, $x_1 + x_2 \leq 3$ and $x_1, x_2 \geq 0$.

Or

- (b) A company makes two types of leather products A and B. Product A is of high quality and product B is of lower quality. The respective profits are Rs.4 and Rs.3 per product. Each product A requires twice as much time as product B and if all products were of type B, the company could make 1000 per day. The supply of leather is sufficient for only 800 products per day (Both A and B combined). Product A requires a special spare part and only 400 per day are available. There are only 700 special spare parts a day available for product B. Formulate this as a L.P.P.

17. (a) Obtain an initial basic feasible solution to the following transportation problem using the north-west corner rule:

	A	B	C	D	E	Supply
P	2	11	10	3	7	4
Q	1	4	7	2	1	8
R	3	9	4	8	12	9
Demand	3	3	4	5	6	

Or

- (b) Obtain an initial basic feasible solution to the following transportation problem using the least cost method:

	D ₁	D ₂	D ₃	D ₄	Capacity
O ₁	1	2	1	4	30
O ₂	3	3	2	1	50
O ₃	4	2	5	9	20
Demand	20	40	30	10	

18. (a) Find the sequence that minimises the total elapsed time required to complete the following tasks on machines M₁ and M₂, in the order M₁, M₂. Also, find the minimum total elapsed time.

Task	A	B	C	D	E	F	G	H	I
M ₁	2	5	4	9	6	8	7	5	4
M ₂	6	8	7	4	3	9	3	8	11

Or

- (b) Determine the strategy for A, B, value of the game for the pay off matrix is given by

$$\text{Player A} \begin{matrix} & \text{Player B} \\ \begin{pmatrix} H & T \\ 2 & -1 \\ -1 & 0 \end{pmatrix} \end{matrix}$$

19. (a) The cost of machine is Rs. 6,100 and its scrap value is Rs.100. The maintenance cost found from experience are as follows:

Year	1	2	3	4	5	6	7	8
Main Cost.:	100	250	400	600	900	1200	1600	2000

When should the machine be replaced?

Or

- (b) Construct the network for the project whose activities and their relationships are as given below:

Activities: A,D,E can start simultaneously.

Activities: B, C>A; G,F>D,C; H>E,F.

20. (a) In a railway marshalling yard, goods train 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 of 36 minutes. Calculate the mean queue size.

Or

- (b) Arrival rate of telephone calls at a telephone booth is according to Poisson distribution, with an average time of 9 minutes between two consecutive arrivals. The length of telephone call is assumed to be exponentially distributed, with mean 3 minutes. Find the average queue length that forms from time to time.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Solve the following LPP by simplex method:

$$\text{Maximize } Z = 3x_1 + 2x_2$$

$$\text{Subject to } 2x_1 + x_2 \leq 2, \quad 3x_1 + 4x_2 \geq 12 \text{ and } x_1, x_2 \geq 0.$$

Or

- (b) Using Big-M method to solve

$$\text{Minimize } Z = 4x_1 + 3x_2$$

$$\text{Subject to } 2x_1 + x_2 \geq 10, -3x_1 + 2x_2 \leq 6, \\ x_1 + x_2 \geq 6 \text{ and } x_1, x_2 \geq 0.$$

Page 8 Code No. : 5549

22. (a) Find the initial basic feasible solution for the following transportation problem by VAM.

	D ₁	D ₂	D ₃	D ₄	Availability
S ₁	11	13	17	14	250
S ₂	16	18	14	10	300
S ₃	21	24	13	10	400
Requirements	200	225	275	250	

Or

- (b) Consider the problem of assigning five jobs to five persons. The assignment costs are given as follows:

Person	Job				
	1	2	3	4	5
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

Determine the optimum assignment schedule.

Page 9 Code No. : 5549

23. (a) Find the sequence that minimises the total elapsed time required to complete the following jobs on machines M_1 , M_2 and M_3 , in the order M_1 , M_2 , M_3 .

Tasks	A	B	C	D	E	F
M_1	8	3	7	2	5	1
M_2	3	4	5	2	1	6
M_3	8	7	6	9	10	9

Or

- (b) Solve the following 2×4 game graphically:

$$\text{Player A} \begin{pmatrix} & \text{Player B} \\ & 1 & 2 & 3 & 4 \\ 1 & 0 & 4 & -1 \\ -1 & 1 & -2 & 5 \end{pmatrix}$$

24. (a) Calculate the earliest start, earliest finish of each activity of the project given below and determine the critical path of the project.

Activity	1-2	1-3	1-5	2-3	2-4	3-4	3-5	3-6	4-6	5-6
Duration	8	7	12	4	10	3	5	10	7	4

Or

- (b) The following table indicates the details of a project. The durations are in days. 'a' refers to optimistic time, 'm' refers to most likely time and 'b' refers to pessimistic time duration.

Activity	1-2	1-3	1-4	2-4	2-5	3-4	4-5
a	2	3	4	8	6	2	2
m	4	4	5	9	8	3	5
b	5	6	6	11	12	4	7

- (i) Draw the network
(ii) Determine the expected standard deviation of the completion time.
25. (a) A telephone exchange has two long distance operators. The telephone company finds that during the peak load, long distance calls arrive in a Poisson fashion at an average rate of 15 per hour. The length of service on these calls is approximately exponentially distributed with mean length 5 minutes.

- (i) What is the probability that a subscriber will have to wait for his long distance call during the peak hours of the day?
(ii) If the subscribers will wait and are serviced in turn, what is the expected waiting time?

Or

(b) A client asks an estate agent to sell three properties A, B and C for him 5% commission on each sale. He specifies certain conditions. The estate agent must sell property A first, and this he must do within 60 days. If and when A is sold the agent receives his 5% Commission on that sale. He can then either back out at this stage or nominate and try to sell one of the remaining two properties within 60 days. If he does not succeed in selling the nominated property in that period, he is not given the opportunity to sell the third property on the same conditions. The prices, selling costs and the estate agent's estimated probability of making a sale are given below.

Property	Price of property	of Selling costs	Probability of sale
A	Rs. 12,000	Rs. 400	0.7
B	25,000	225	0.6
C	50,000	450	0.5

Draw up an appropriate decision tree for the estate agent.