BRAINWARE UNIVERSITY

Term End Examination 2020 - 21

Programme – Master of Computer Applications

Course Name – Operation Research

Course Code - MCA305

Semester / Year - Semester III

Time allotted : 85 Minutes | Full Marks : 70

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 70=70

1. *(Answer any Seventy)*

(i) An investor has Rs 20 lakhs with her and considers three schemes to invest the money for one year.The expected returns are 10%, 12% and 15% for the three schemes per year. The third scheme accepts only up to 10 lakhs. The investor wants to invest more money in scheme 1 than in scheme 2.The investor assesses the risk associated with the three schemes as 0 units, 10 units and 20 units per lakh invested and does not want her risk to exceed 500 units. How many decision variables are in your formulation?

a) 1 b) 2

c) 3 d) 4

(ii) Two tasks have to be completed and require 10 hours and 12 hours of work if one person does the tasks. If n people do task 1, the time to complete the task becomes 10/n and so on. Similarly if n people do task 2, the time becomes 12/n and so on. We have 5 people and they have to be assigned to the two tasks. We cannot assign more than three to task 1. Find the earliest time that both tasks are completed if they start at the same time. (Use ideas from the bicycle problem to write your objective function. At some point you may have to define a variable to represent the reciprocal of another variable). Formulate an LP problem and answer the following:The final objective function is

a) Maximization problem with one term in the objective function

b) Minimization problem with one term in the objective function

c) Maximization problem with two terms in the objective function

d) Minimization problem with two terms in the objective function

(iii) Two tasks have to be completed and require 10 hours and 12 hours of work if one person does the tasks. If n people do task 1, the time to complete the task becomes 10/n and so on. Similarly if n people do task 2, the time becomes 12/n and so on. We have 5 people and they have to be assigned to the two tasks. We cannot assign more than three to task 1. Find the earliest time that both tasks are completed if they start at the same time. (Use ideas from the bicycle problem to write your objective function. At some point you may have to define a variable to represent the reciprocal of another variable). Formulate an LP problem and answer the following: The total number of constraints in the final formulation is

a) 1 b) 2

c) 3 d) 4

(iv) TV sets are to be transported from three factories to three retail stores. The available quantities are 300, 400 and 500 respectively in the three factories and the requirements are 250, 350 and 500 in the three stores. They are first transported from the factories to warehouses and then sent to the retail stores. There are two warehouses and their capacities are 600 and 700 units. The unit costs of transportation from the factories to warehouses and from the warehouses to retail stores are known. Formulate an LP and answer the following questions: The number of constraints in the formulation is

a) 6 b) 8

c) 10 d) 12

(v) Thousand answer papers have to be totaled in four hours. There are 10 regular teachers, 5 staff and 4 retired teachers who can do the job. Regular teachers can total 20 papers in an hour; staff can do 15 per hour while retired teachers can do 18 per hour. The regular teachers total the papers correctly 98% of the times while this number is 94% and 96% for staff and retired teachers. We have to use the services of at least one staff. You can assume that any person can work for a fraction of an hour also. Formulate a relevant LP problem and answer the following questions.Which of the following is a correct decision variable for this problem

a) Number of answer papers given to teachers 1 to 10

b) Total number of answer papers given to regular teachers

c) Number of papers correctly totaled by regular teachers

d) Number of papers incorrectly totaled by the reg

(vi) Thousand answer papers have to be totaled in four hours. There are 10 regular teachers, 5 staff and 4 retired teachers who can do the job. Regular teachers can total 20 papers in an hour; staff can do 15 per hour while retired teachers can do 18 per hour. The regular teachers total the papers correctly 98% of the times while this number is 94% and 96% for staff and retired teachers. We have to use the services of at least one staff. You can assume that any person can work for a fraction of an hour also. Formulate a relevant LP problem and answer the following questionsThe number of constraints in the formulation is

a) 5

b) 10

c) 19

d) 20

(vii) A person is in the business of buying and selling items. He has 10 units in stock and plans for the next three periods. He can buy the item at the rate of Rs 50, 55 and 58 at the beginning of periods 1, 2 and 3 and can sell them at Rs 60, 64 and 66 at the end of the three periods. He can use the money earned by selling at the end of the period to buy items at the beginning of the next period. He can buy a maximum of 200 per period. He can borrow money at the rate of 2% per period at the beginning of each period. He can borrow a maximum of Rs 8000 per period and he cannot borrow more than Rs 20000 in total. He has to pay back all the loans with interest at the end of the third period.How many decision variables are in the formulation

a) 3

b) 6

c) 9

d) 10

(viii) A food stall sells idlis, dosas and poories. A plate of idli has 2 pieces, a plate of dosa has 1 piece while a plate of poori has 2 pieces. They also sell a “combo” which has 2 idlis and 2 poories. A kg of batter costs Rs 60 and contains twelve spoons of batter. Each piece of idli requires 1 spoon of batter and each dosa requires 1.5 spoons of batter. Each poori piece requires 1 ball of wheat dough and a kg of wheat dough that costs Rs 60 can make 20 balls of dough. The selling prices of the items are Rs 40,60, 60 and 90 per plate

respectively. The owner has Rs 800 with her and estimates the demand for the four items (in plates) as 50, 30, 20 and 10 respectively. There is a penalty cost of Rs 10 for any unmet plate of demand of an item. Idli being the most commonly consumed item, the owner wishes to meet at least 80% of the demand. Formulate an LP problem and answer the following questions: What is the most suitable objective function for this problem?

a) Maximize the total money earned by sale
b) Maximize the total money earned by sale less the cost of items bought
c) Maximize the total plates made of all the items
d) Minimize the unmet demand

(ix) Consider the maximum flow problem with n nodes and m arcs. You are writing a formulation with f as the maximum flow.The total number of variables is _____

a) m+1
b) n+1
c) m+n+1
d) m.n+1

(x) Consider the maximum flow problem with n nodes and m arcs. You are writing a formulation with f as the maximum flow.The total number of constraints is _____

a) m
b) n
c) m+n
d) m.n

(xi) Consider the media selection problem with n possible things to invest in. Examples could be TV, radio, newspaper etc. There is a total budget restriction and limit on investment in each. The number of constraints is _____

a) n
b) n+1
c) n+2
d) n+3

(xii) The primal has m constraints and n variables. The dual has ___ constraints and ___variables

a) m.m
b) n.n
c) m.n
d) m.m

(xiii) In the optimum solution, if a primal constraint is satisfied as an equation, the value of the corresponding dual variable is ___

a) Positive
b) Negative
c) Zero
d) Can't be said.

(xiv) In the optimum solution, if a primal variable is basic then the corresponding dual slack value is ___

a) Positive
b) Negative
c) Zero
d) Can't be said.

(xv) Consider a transportation problem with 3 supply points and 4 demand points. The number of constraints in the formulation is

a) 3
b) 6
c) 7
d) 10

(xvi) In the dual to the transportation problem, the dual variables are

a) ?0
b) 0?
c) Unrestricted
d) None of these

(xvii) Which of the following statements about the northwest corner rule is false?

a) One must exhaust the supply for each row before moving down to the next row
b) One must exhaust the demand requirements of each column before moving to the next column
c) When moving to a new row or column, one must select the cell with the lowest cost.
d) One must check that all supply and demand constraints are met.

(xviii) When the number of shipments in a feasible solution is less than the number of rows plus the number of columns minus one

a) the solution is optimal
b) there is degeneracy, and an artificial allocation must be created

c) a dummy source must be created

d) . a dummy destination must be created

(xix) The stepping-stone method

a) is an alternative to using the northwest corner rule

b) often involves tracing closed paths with a triangular shape

c) is used to evaluate the cost effectiveness of shipping goods via transportation routes not currently in the solution

d) is used to identify the relevant costs in a transportation problem

(xx) In a minimization problem, a positive improvement index in a cell indicates that

a) the solution is optimal

b) the total cost will increase if units are reallocated to that cell

c) the total cost will decrease if units are reallocated to that cel

d) there is degeneracy

(xxi) An improvement index indicates

a) whether a method other than the stepping stone should be used

b) b. whether a method other that the northwest corner rule should be used

c) whether the transportation cost in the upper left-hand corner of a cell is optimal

d) how much total cost would increase or decrease if a single unit was reallocated to that cell

(xxii) How many variables does the formulation of 5 x 5 assignment problem have?

a) 20

b) 25

c) 30

d) 35

(xxiii) How many variables does the dual of 5 x 5 assignment problem have?

a) 9

b) 10

c) 11

d) 12

(xxiv) Which of the following statements is not TRUE about the Assignment problem:

a) It is a transportation problem

b) The LP formulation will give binary solutions

c) When solving, the cost matrix is square

d) LP can give non integer solution sometimes

(xxv) In a 4 x 4 assignment problem where 4 jobs are assigned to 4 machines, job 1 is Assigned to M2, job 2 to M4, Job 3 to M3. What is the fourth assignment?

a) a. Job 4 to M2

b) Job 4 to M1

c) Job 4 to M3

d) Job 4 to M4

(xxvi) The objective function value at the optimum is _____

a) 9

b) 10

c) 11

d) 12

(xxvii)

Consider the LP problem:

Maximize $7X_1 + 6X_2 + 4X_3$

subject to

$X_1 + X_2 + X_3 ? 5$

$2X_1 + X_2 + 3X_3 ? 10$

$X_1, X_2, X_3 ? 0.$

Solve by algebraic method and answer the following:

The number of basic solutions is _____

a) 8
b) 9
c) 10
d) 11

(xxviii)

Consider the LP problem:

Maximize $7X_1 + 6X_2 + 4X_3$

subject to

$X_1 + X_2 + X_3 ? 5$

$2X_1 + X_2 + 3X_3 ? 10$

$X_1, X_2, X_3 ? 0.$

Solve by algebraic method and answer the following:

The number of basic infeasible solutions is _____

a) 1
b) 2
c) 3
d) 4

(xxix)

Consider the LP problem:

Maximize $7X_1 + 6X_2 + 4X_3$

subject to

$X_1 + X_2 + X_3 ? 5$

$2X_1 + X_2 + 3X_3 ? 10$

$X_1, X_2, X_3 ? 0.$

Solve by algebraic method and answer the following:

The number of unique basic feasible solutions is _____

a) 3
b) 4
c) 5
d) 6

(xxx)

Consider the LP problem:

Minimize $6X_1 + 5X_2$

subject to

$X_1 + X_2 ? 3$

$2X_1 + X_2 ? 5$

$X_1, X_2 ? 0.$

Solve by algebraic method and answer the following :

The number of basic feasible solutions is ___

a) 1
b) 3
c) 4
d) 5

(xxxi)

Consider the LP problem:

Minimize $6X_1 + 5X_2$

subject to

$X_1 + X_2 ? 3$

$2X_1 + X_2 ? 5$

$X_1, X_2 ? 0.$

Solve by algebraic method and answer the following :The value of objective function at optimum is

a) 17
b) 18
c) 27
d) 28

(xxxii)

Consider the LP problem:

Minimize $6X_1 + 5X_2$

subject to

$X_1 + X_2 ? 3$

$2X_1 + X_2 ? 5$

$X_1, X_2 ? 0.$

Solve by algebraic method and answer the following :The optimum solution has $X_1 =$ _____

a) 0
b) 1
c) 1.5
d) 2

(xxxiii)

Consider the LP problem

Minimize $3X_1 + 8X_2$

subject to

$3X_1 + 5X_2 ? 16$

$5X_1 + 3X_2 ? 12$
$X_1, X_2 ? 0.$

The number of variables in the simplex table for this problem is ____.

a) 4
b) 5
c) 6
d) 7

(xxxiv)

Consider the LP problem:

Maximize $7X_1 + 6X_2$

subject to

$X_1 + X_2 ? 4$

$2X_1 + X_2 ? 6$

$X_1, X_2 ?0.$

Solve using the algebraic form of the simplex algorithm and answer the following:When X_2 enters the solution, the value it takes is _____

a) 1
b) 2
c) 3
d) 4

(xxxv)

Consider the LP problem:

Maximize $7X_1 + 6X_2$

subject to

$X_1 + X_2 ? 4$

$2X_1 + X_2 ? 6$

$X_1, X_2 ?0.$

Solve using the algebraic form of the simplex algorithm and answer the following:At the optimum, the coefficient of variable X_3 in the objective function is _____

a) 2
b) 5
c) -2
d) -5

(xxxvi)

Solve the LP problem

Maximize $3X_1 + 8X_2$

subject to

$3X_1 + 5X_2 ? 16$

$5X_1 + 3X_2 ? 12$

$X_1, X_2 ? 0$

Using the simplex algorithm.The value of objective function at optimum is _____

a) 25.2
b) 25.4
c) 25.6
d) 25.8

(xxxvii)

Solve the LP problem

Maximize $4X_1 + 3X_2 + 5X_3$

subject to

$X_1 + X_2 + X_3 ? 10$

$2X_1 + X_2 + 3X_3 ?20$

$3X_1 + 2X_2 + 4X_3 ? 30$

$X_1, X_2, X_3 ? 0$ using the simplex algorithm and answer the following questions. If you have to decide a leaving variable, break the tie arbitrarily.How many iterations will you take to obtain the optimal solution?

a) 1
b) 2
c) 3
d) 4

(xxxviii)

Solve the LP problem

Maximize $4X_1 + 3X_2 + 5X_3$

subject to

$X_1 + X_2 + X_3 ? 10$

$2X_1 + X_2 + 3X_3 ?20$

$3X_1 + 2X_2 + 4X_3 ? 30$

$X_1, X_2, X_3 ? 0$ using the simplex algorithm and answer the following questions. If you have a tie to decide a leaving variable, break the tie arbitrarily.How many basic

a) 1
b) 2
c) 3
d) 5

(xxxix)

Solve the LP problem

Maximize $9X_1 + 3X_2 + 5X_3$

subject to

$4X_1 + X_2 + X_3 ? 12$

$2X_1 + 4X_2 + 3X_3 ? 22$

$5X_1 + 2X_2 + 4X_3 ? 34$

$X_1, X_2, X_3 ? 0$ using the simplex algorithm and answer the following questions.

The set of basic variables at the optimum is

a) X1X2X6
b) X1X3X5
c) X1X3X6
d) X2X3X6

(xl)

Solve the LP problem using Simplex algorithm

Minimize $9X_1 + 3X_2$

subject to

$4X_1 + X_2 ? 12$
$7X_1 + 4X_2 ? 16$

$X_1, X_2 ? 0$ using the simplex algorithm.

Which of the following is the correct answer

a)

The optimum solution is (0, 4)

b)

The problem is unbounded

c)

The problem is infeasible with simplex showing artificial variable $a_1 = 20/7$ at optimum

d)

The problem is infeasible with simplex showing artificial variable $a_1 = 3$ at optimum

(xli)

Solve the LP problem using Simplex algorithm

Minimize $2X_1 + 3X_2$

subject to

$X_1 + X_2 ? 4$

$X_1 ?1$

$X_1, X_2 ? 0$ using the simplex algorithm.The value of X_2 at the optimum is ____

a) 1
b) 2
c) 3
d) 4

(xlii)

Solve the LP problem using Simplex algorithm

Minimize $2X_1 + 3X_2$

subject to

$X_1 + X_2 ? 4$

$X_1 ?1$

$X_1, X_2 ? 0$ using the simplex algorithm.If we add the constraint $2X_1 + 3X_2 ? 11$

a) The optimum solution remains the same
b) The problem becomes infeasible
c) The problem becomes unbounded
d) The optimum solution changes

(xliii)

Consider the LP

Maximize $7X_1 + X_2$

subject to $X_1 + X_2 ? 3$

$X_1 + X_2 ? 2$

$X_2 ? 0, X_1$
unrestricted. Which of the following is NOT TRUE about the dual

a) The first constraint is an equation

b) The second constraint is an equation

c) The second variable is of ? type

d) The dual has two variables and two constraints

(xliv)

Given the LP problem

Maximize $3X_1 + 5X_2 + 9X_3$

subject to $X_1 + X_2 + 2X_3 ? 6$

$2X_1 + 3X_2 + X_3 ?8$

$X_1, X_2, X_3 ? 0$

The dual has _____ variables

a) 1

b) 2

c) 3

d) 4

(xlv)

Consider the LP

Maximize $2X_1 + 3X_2 + 4X_3 + X_4$

subject to $X_1 + 2X_2 + 5X_3 + X_4$? 12.

Xj ? 0. Solve the dual and find the optimum solution to the primal.

The value of the objective function at the optimum is ____

a) 18 b) 20

c) 22 d) 24

(xlvi)

Consider the LP

Maximize $2X_1 + 3X_2 + 4X_3 + X_4$

subject to $X_1 + 2X_2 + 5X_3 + X_4$? 12.

Xj ? 0. Solve the dual and find the optimum solution to the primal

If 100 units of the resource are available, the value of the objective function at

optimum is _____

a) 120 b) 180

c) 200 d) 240

(xlvii)

Consider a two variable LP problem with a minimization objective function and three

constraints all of the ? type. The first constraint cuts the X_1 and X_2 axes at 2 and 7

respectively. The second constraint cuts the two axes at 3 and 5 respectively and the third constraint at 4 and 4 respectively. The objective function is $3X_1 + 2X_2$.

Which of the following is not a valid constraint for this problem

a)

$7X_1 + 2X_2 ? 14$

b)

$4X_1 + 5X_2 ? 20$

c)

$5X_1 + 3X_2 ? 15$

d)

$X_1 + X_2 ? 4$

(xlviii)

Consider a two variable LP problem with a minimization objective function and three constraints all of the ? type. The first constraint cuts the X_1 and X_2 axes at 2 and 7 respectively. The second constraint cuts the two axes at 3 and 5 respectively and the third constraint at 4 and 4 respectively. The objective function is $3X_1 + 2X_2$

Which of the following is not a corner point for the feasible region

a)

(0,0)

b)

(4,0)

c)

(12/11, 35/11)

d)

(3/2, 5/2)

(xlix)

Consider the assignment problem with 4 jobs and 3 machines. The job that is not assigned to any machine is

1	1	4
6	7	2
8	4	3
5	6	7

a)

b)

Job 1

Job 2

c)

d) Job 4

Job 3

(l)

Solve the 4 x 4 maximization assignment problem. The maximum profit is

1	1	4	8
6	7	2	7
8	4	3	6
5	6	7	8

a) 20

b) 30

c) 32

d) 40

(li)

Consider the following assignment problem. When you solve it by hand, the number of assignments that you get in the first iterations is ____.

20	17	22	16
32	29	33	26
26	27	29	28
40	30	35	37

a) 2
b) 3
c) 4
d) 5

(lii)

What is the traveling salesman problem equivalent to in graph theory?

a) Any circuit.
b) A Hamilton circuit in a non-weighted graph.
c) A round trip airfare.
d) A Hamilton circuit in a weighted graph.

(liii)

In a fair game the value of the game is

a) Positive
b) 0
c) Negative
d) Can't say anything

(liv)

In game theory, a situation in which one firm can gain only what another firm loses is called a

a)
b)

nonzero-sum game.

prisoners' dilemma.

c)

d)

zero-sum game.

cartel temptation

(lv)

Game theory is concerned with

a)

b)

predicting the results of bets placed on games like roulette

the choice of an optimal strategy in conflict situations.

c)

d)

maximization by firms in perfectly competitive markets

the migration patterns of caribou in Alaska

(lvi)

Which of the following is a nonzero-sum game?

a)

b)

Prisoners' dilemma

Chess

c)

d)

A cartel member's decision regarding whether or not to cheat

All of these

(lvii)

In which of the following games do all players follow the same strategy regardless of the other player's strategy in each play of the game?

a)

b)

Constant strategy

Mixed strategy

c)

d)

Pure strategy

Dominance strategy

(lviii)

In a mixed strategy, each player should optimize the

a)

maximum payoffs.

b)

lower value of the game.

c)

minimum loss.

d)

expected gain.

(lix)

Considering the following two-person game, the value of the game (if played many times) is

	Y_1	Y_2
X_1	6	3
X_2	2	8

a) 19.00

b) 4.75

c) 11.00

d) None of these

(lx)

Given the following two-person game, which strategy can be eliminated by use of dominance?

	Y_1	Y_2
X_1	9	13
X_2	12	8
X_3	6	14

a)

b)

X_1

X_2

c)

d) None of these

X_3

(lxi)

In a zero sum game

a)

b)

The sum of the payoffs for any given strategy pair is zero.

The gain of one of the players is equal to the loss of the other player.

c)

d)

It is impossible for both players to earn positive profits for the same strategy pair.

All of these are true for zero sum games.

(lxii)

Full form of PERT is

a)

b)

Program Estimation & Review Technique

Project Evaluation & Review Technique

c)

d)

Project Estimation & Research Technique

Program Evaluation & Review Technique

(lxiii)

An activity is said to be critical activity if

a)

b)

Its free float is zero

its total float is zero

c)

d)

its independent float is zero

its time duration is zero.

(lxiv)

Let the time estimates for the activities have the values t_o = 6 days, t_m = 8 days, t_p = 10 days. Then the expected time t_e is (where the symbols have their usual meanings)

a)

7 days

b)

8 days

c)

9 days

d)

10 days

(lxv)

The full form of CPM is

a)

Crash project management

b)

Critical path management

c)

Critical path method

d) None of these

(lxvi)

Which of these is not correct

a)

PERT is probabilistic in nature.

b)

CPM is deterministic in nature

c)

CPM is event-oriented

d)

CPM and PERT use similar terminology but were developed independently.

(lxvii)

Which of the following is not correct in respect of PERT calculations?

a)

Expected time of an activity is a weighted average of the optimistic, pessimistic and most likely estimates

b)

The completion time of an activity is assumed to follow normal distribution

c)

The completion time of an activity is assumed to follow normal distribution

d)

The total variance of the critical activities gives the variance of the overall project completion time

(lxviii)

Mark the wrong statement.

a)

All activities on a critical path are critical activities

b)

A project network may have none, one, or more critical paths.

c)

Completion of a critical activity surely delays the project

d)

Each critical activity has identical earliest and the latest start times

(lxix)

Pick the wrong relationship:

a)

Interfering float = Total float – Free float

b)

Total float =Free float + Independent float

c)

Total float ? Free float ? Independent float

d)

Free float = Total float – Head event slack

(lxx)

Mark the wrong statement here.

a) An activity that represents the initiation of more than one event is called the burst event

b)

c) [illegible] allocate

d) A non-critical activity may or may not have any free float.