

KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

Mark Scored:

Level : B. Sc.

Course : COMP 317

Year : III

Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date SEP: 10 2017

SECTION "A"

[10 Q × 0.5 = 5 marks]

Fill in the blank(s) (question number 1 through 10) by the most appropriate word(s) or symbol(s):

1. One method of solving integer programming problem is branch and bound method and other method is called _____
2. Assignment problem can be converted into _____
3. The problem which concerns with the optimal allocation of resources is called _____
4. If $r_0 = 67$, $m = 10$, $p = 6$ then first random $r_1 =$ _____
5. Degenerate solution of transportation problem can be made non-degenerate by assigning $\epsilon \geq 0$ to the non basic cell which has _____
6. In salesman problem if traveling salesman has to travel n cities starting from any one of cities then number of ways of his tour planes = _____
7. Probability of system being empty in M/M/s queueing system is given by the formula _____
8. The sequence of critical activities between the start event and end event is called _____
9. In a queueing system, if a customer arrives, it gets immediately service even a customer is already in the hand of server then such customer is named as _____
10. Simulation is not _____ technique.

SECTION "B"

[10Q × 0.5 = 5 marks]

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from among the given ones. Do not tick the answers.

11. If in a multi-server queue $\lambda = 8$ per hour, $\mu = 6$ per hour and $s=4$ then the proportion of time that the server is busy is _____
[0.33, 0.66, 1.33, 2.66]

12. Dual constraints for the minimization LP-problem is _____
 [$\sum a_{ij} y_i \geq C_j$, $\sum a_{ji} y_i \geq C_j$, $\sum a_{ij} y_j \leq C_j$, $\sum a_{ji} y_i \leq C_j$]

13. Assignment problem is the special types of transportation problem with supply and demand amounts taken to be _____
 [1, 1.1, 100, 101]

14. If for a given optimal solution of LP-problem the value of surplus comes out to be non-zero then it indicates that _____
 (i) The solution is optimal.
 (ii) The solution is infeasible.
 (iii) The entire amount of resource with the constraint in which the slack variable appears has been consumed.
 (iv) Shortage of resources.

15. _____ is not the terminology of simulation.
 (i) Random number (ii) Probability (iii) Optimization (iv) Monte-Carlo

16. While solving the LP problem by simplex method sometimes artificial variable still stays in the basis even after the optimization criterion is met then the problem is said to have _____
 [Feasible solution, non-feasible solution, basic solution, non-basic solution]

17. The objective function of assignment problem for the assignment of i^{th} job to j^{th} machine is

$$\begin{aligned} \text{Minimize } Z &= \sum_{j=1}^n \sum_{i=1}^n c_{ij} x_{ij} & \text{Minimize } Z &= \sum_{j=1}^{n+1} \sum_{i=1}^n c_{ij} x_{ij} \\ \text{Minimize } Z &= \sum_{j=1}^{n+1} \sum_{i=1}^{n-1} c_{ij} x_{ij} & \text{Minimize } Z &= \sum_{j=1}^n \sum_{i=1}^{n+1} c_{ij} x_{ij} \end{aligned}$$

18. _____ is not the assumption of travelling salesman problem
 (i) Traveler should know the number of cities to be visited.
 (ii) Cost of travelling from one city to another.
 (iii) City from which the tour to be started.
 (iv) Number of travelers per route per day.

19. Minimization $Z = 6x_1 + 4x_2$ subject to the constraints $x_1 + x_2 \leq 5$, $x_2 \leq 8$, $x_1, x_2 \geq 0$ has slack variable value $S_2 = 2$ then it means that _____
 (i) Shortage of second resource by amount 2
 (ii) Unused of second resource by amount 2
 (iii) Objective function value increases by amount 2
 (iv) Objective function value decreases by amount 2

20. In network analysis formula $E_j - E_i - t_{ij}$ is for _____
 [Total float, Free float, Independent float, Critical path]

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SECTION "C"

[3 Q × 7 = 21 marks]

1. State basic characteristics of queueing system. In a car-wash service facility, cars arrive for service according to Poisson distribution with mean 5 per hour. The time for washing and cleaning each car has exponential distribution mean 10 minutes per car. The facility cannot handle more than one car at a time and has a total of 5 parking spaces construct the network diagram for the project. [1+3+3]
 a) Find the probability that an arriving car will get service immediately upon arrival
 b) Find the expected number of parking spaces occupied.

2. The owner of a chain of fast food restaurant is considering a new computer system for accounting and inventory control. A computer company sent the following information about the computer installation: [3+2+2]

Activity	Activity description	Immediate predecessor	Times(days)		
			t_0	t_m	t_p
A	Select the computer model	---	4	6	8
B	Design input/output systems	A	5	7	15
C	Design monitoring systems	A	4	8	12
D	Assemble computer hardware	B	15	20	25
E	Develop the main programs	B	10	18	26
F	Develop input/output routines	C	8	9	16
G	Create data base	E	4	8	12
H	Install the system	D,F	1	2	3
I	Test and implement	G,H	6	7	8

- a) Construct the network diagram for the project
 b) Find the expected completion time of the project
 c) Find the probability of completing the project in 55 days
3. Explain key difference between Big-M method and dual simplex method. Use dual simplex method to solve the following linear programming problem. [6+1]

$$\text{Minimize } Z = 2x_1 + 2x_2 + x_3 + 4x_4$$

Subject to

$$2x_1 + 4x_2 + 5x_3 + x_4 \geq 10,$$

$$3x_1 - x_2 + 7x_3 - 2x_4 \geq 2$$

$$5x_1 + 2x_2 + x_3 + 6x_4 \geq 15$$

$$x_1, x_2, x_3, x_4 \geq 0$$

OR

Discuss what do we see in phase-wise proceeding of solution of linear programming problem in Two-phase-method? Solve the following LP-problem by using Two-Phase method: [1+6]

Minimize $Z = 2x_1 + x_2$ subject to

$$5x_1 + 10x_2 - x_3 = 8$$

$$x_1 + x_2 + x_3 = 1$$

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

SECTION "D"

[5 Q × 5 = 25 marks]

4. Transportation problem is the special type of general linear programming problem, justify it. A company has factories F_1, F_2, F_3 which supply to warehouses W_1, W_2, W_3 . Weekly factory capacities are 200, 160, and 90 units respectively. Weekly warehouse requirements are 180, 120, and 150 units respectively. Unit shipping costs (in Rupees) are as follows: Find the optimal distribution for this company to minimize total shipping cost. [1+4]

	W_1	W_2	W_3
F_1	16	20	12
F_2	14	8	18
F_3	26	24	16

5. Differentiate between transportation problem and assignment problem. Four persons P_1, P_2, P_3, P_4 have to do five jobs J_1, J_2, J_3, J_4, J_5 . Each job is to be done by one person only. Each person does exactly one job except P_2 who can do J_2 job. Cost involved in assigning a job to a person is given in the table below. Find the optimal assignment which minimizes the total cost. [1+4]

	J_1	J_2	J_3	J_4	J_5
P_1	6	4	5	7	8
P_2	7	5	8	6	9
P_3	8	6	7	9	10
P_4	5	7	8	4	6

6. Why do we need simulation in queueing system when we have conventional formulas for the system? In a single channel queueing system random numbers for arrivals of customers are 21, 81, 92, 23, 96, 20, 68, 57 and random numbers for services of customers are 11, 28, 10, 55, 82, 72, 95, 08 and using Monte Carlo simulation for the queueing system for 10 periods for the table given below: Find [1+4]
- Mean queue length.
 - Mean inter arrival time of a customer
 - Mean service time of a customer.
 - Mean idle time of server.
 - Mean time that a customer spends in the system
 - Mean number of customers waiting in the queue.

Inter-arrival time (min)	Probability	Service time (min)	Probability
5	0.15	7	0.10
6	0.35	10	0.35
7	0.40	9	0.45
8	0.10	15	0.10

7. For the linear programming problem : Minimize $Z = x_2 - 3x_3 + 2x_5$ subject to

$$3x_2 - x_3 + 2x_5 \leq 7$$

$$-2x_2 + 4x_3 \leq 12$$

$$-4x_2 + 3x_3 + 8x_5 \leq 10$$

$$x_2, x_3, x_5 \geq 0$$

[1+2+2]

Whose optimal table is

		C_j	1	-3	2	0	0	0
C_B	Basis	$X_B = b$	x_2	x_3	x_5	s_1	s_2	s_3
1	x_2	4	1	0	4/5	2/5	1/10	0
-3	x_3	5	0	1	2/5	1/5	3/10	0
0	s_3	11	0	0	10	1	-1/2	1
		$Z_j - C_j$	0	0	-12/5	-1/5	-4/5	0

(i) Find dual prices of the problem.

(ii) If x_3 is forced to the solution then what does it impact on the objective function value?

(iii) If first resource is increased by unit amount then what is its new objective function value?

OR

Show that the following LP-problem has alternative optimum solution

Maximize $Z = 6x_1 + 3x_2$ Subject to

$$2x_1 + x_2 \leq 8$$

$$3x_1 + 3x_2 \leq 18$$

$$x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

8. Diet for a sick person must contain at least 4,000 units of vitamins, 50 units of minerals and 1,400 calories. Two foods A and B are available at a cost of Rs. 4/- and Rs. 3/- per unit respectively. If one unit of A contains 200 units of vitamins, 1 unit of mineral and 40 calories and one unit of B contains 100 units of vitamins, 2 units of minerals and 40 calories. [3+2]

(a) Set up the Mathematical model as the linear programming problem and

(b) Find by the graphical approach, the optimal values of foods is used to have the least cost?

SECTION "D"
[2Q × 2= 4 marks]

9. Explain Gomory's cutting plane as one of the method of solving integer programming problem.
10. Convert the following transportation problem into linear programming problem.

	D1	D2	D3	a_i
O1	12	10	11	10
O2	13	12	15	12
O3	16	14	23	20
b_j	26	14	2	