KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2024

Marks Scored:

Level : B.Sc.
Year : III

Course : COMP 317
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 16 DEC 2024

SECTION "A"
[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s) by most appropriate words or symbol(s):

1. If total float of non-critical activity is 10 days, Earliest start time is 5 day and time from one node to other is 4 days, then latest finish time is _____

2. Minimize $Z = 100x_1 + 70x_2$ subject to constraints $8x_1 + 9x_2 \geq 300, 12x_1 + 13x_2 \leq 200, x_1, x_2 \geq 0$ has dual objective function as _____

3. In Simplex table the elements of $Z_j - C_j$ *row* corresponding to non-basic variables is called _____

4. Assignment problem is the special type of _____

5. If the optimistic time, most likely time and pessimistic time respectively are 5,7,12 then expected time of an activity = _____

6. If one of the basic variables has its value in X_{B_i} −column then solution is called _____

7. While numbering the nodes of project network head node gets _____ than head node.

8. From the perspective of cost of providing the service to the customers outs of M/M/10/60 and M/M/10/9 one should choose to use _____

9. If $x_1, x_2 \in S$, *and* $0 \leq \lambda \leq 1$ *then S is said to be convex set if* _____

10. If distance travelled is known between pair of cities, then objective function of travelling salesman problem is minimize Z = _____

SECTION "B"

[10 Q. × 0.5 = 5 marks]

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from the given MCQs. **DO NOT TICK** the answers.

11. If for maximizing primal LP-problem the dual variable $y_5 = 100$ indicates that_____ _____.

[The objective function value decreases by 100 when Fifth resource is increased by unit amount
The objective function value increases by 100 when Fifth product is increased by unit amount
The objective function value increases by 100 when Fifth resource is increased by unit amount
The objective function value decreases by 100 when Fifth product is increased by unit amount]

12. _____ is the assumption of travelling salesman.

[The travelling salesman is the random walk problem from city to city
The priority visit of the city is the prime objective of travelling salesman problem
Back-trekking is allowed in the travelling salesman
The cost or time or distance between pair city should be known priorly by the salesman]

13. Intersection of all convex sets that contains S is called _____.

[Upper hyperplane Lower hyperplane Convex hull Convex polygone]

14. CPM stands for _____.

[Control Path Management Critical Plan Management
Critical Path Method Control Path Method]

15. If transportation problem has $(m + n)$ constraints, then number of basic cells $= (m + n - 1)$ indicates_____.

[there are mn variables dependent there are m variables dependent
there are n variables dependent there is 1 variable dependent]

16. If there are n workers and n jobs in the assignment problem then there would be _____ solutions.

[$n!$ $(n-1)!$ $(n!)^n$ n]

17. In queueing system from Poisson formula if $\boldsymbol{\lambda = \frac{1}{6}}$ ***per minutes*** the probability of zero arrival in 3 minutes as _____.

[0.506 0.606 0.706 0.806]

18. Main objective of Assignment problem is to _____ _____.

[Reduce the cost of assignment to zero Reduce the cost of particular assignment to zero
Minimize the total cost of assignment Find feasible solution]

19. If optimal table of transportation problem shows one of the non-basic cells $d_{ij} = 0$ indicates _____.

[Optimal solution is degenerate Optimal solution is non-degenerate
Problem gets alternative solution Problem gets not alternative solution]

20. In project network analysis, critical activity has floating_____.

[*positive* Negative Zero Not a fixed value]

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Time : 2 hrs. 30mins.

Course : COMP 317
Semester : I
F. M. : 50

SECTION "C"
[3 Q. × 7 = 21 marks]

1. A company produces two products X, Y and has a total production capacity of 9 tonnes per day. Both X and Y requires the same production capacity. The company has a permanent contract to supply at least 2 tonnes of X and at least 3 tonnes of Y per day to another company. Each tonne of X requires 20 machine hours of production time and each tonne of Y requires 50 machine hours of production time. The daily maximum possible number of machine hours is 360.All of the firm's output can be sold. The profit made is Rs.80 per tonne of X and Rs.120 per tonne of Y.
   a. Set up the Mathematical model of the problem as the linear programming problem.
   b. By using graphical approach find how many tons of each product should the company produce in order to maximize its profit. [3.5+3.5]

OR

$Maximize\ Z = 5x_1 + 3x_2;$
$subject\ to\ x_1 + x_2 \leq 2\ ; 5x_1 + 2x_2 \leq 10\ ,\ 3x_1 + 8x_2 \leq 12;\ x_1, x_2 \geq 0$ has the following optimal solution table:

		C_j	5	3	0	0	0
C_B	B	X_{B_i}	x_1	x_2	s_1	s_2	s_3
5	x_1	2	1	1	1	0	0
0	s_2	0	0	-3	0	1	0
0	s_3	6	0	5	0	0	1
Z_j			5	5	5	0	0
$Z_j - C_j$			0	2	5	0	0

   a. State optimal solution set
   b. State whether the solution is non-degenerate or not
   c. State basic variables and non-basic variables
   d. Value of $s_3 = 6$ what does it mean?
   e. Does this problem possess alternative solution? give reason
   f. State from the table the solution for dual variables.
   g. What is the new objective function value when x_2 is introduced into soluti

P.T.O.

2. Service random numbers as: 21,81,90,66,49 the following table are the probability distribution for the arrival and service time distribution: System starts at 10:00 AM [7]

Inter arrival time (Min)	Probability	Service time (Min)	Probability
10	0.35	15	0.25
5	0.20	10	0.15
7	0.10	20	0.30
12	0.05	5	0.10
15	0.20	8	0.15
8	0.10	25	0.05

a. Find the mean number of customers waiting in queue
b. Find mean idle time of the servers
c. Find expected time that a customer has to wait
d. Find percentage time that a server remains busy
e. Find mean inter-arrival time of customer
f. Find mean time of a server that he has given for a service

3. A sales man has to visit five cities A, B, C, D. The distance between pair of cities in (hundred kilometer) are given the table below then find the optimal routing schedule so as minimize the distance of travelling

From City	To city				
		A	B	C	D
	A	---	1	6	8
	B	7	---	8	5
	C	6	8	---	9
	D	8	5	9	---

SECTION "D"

[5 Q. × 5 = 25 marks]

4. What is the great role of Big-M in Charne's Big-M method? Use it to find the optimal solution of following LP-problem: $Maximize\ Z = x_1 - x_2 + 3x_3$ Subject to

$$x_1 + x_2 \leq 20;\ x_1 + x_3 = 5;\ x_2 + x_3 \geq 10$$

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

5. For the following activities of the project (a) Draw the network diagram of the project (b)Find expected time to complete the project (c) Find the probability that project can be completed in 40 days [2+1+2]

Activity	1-2	2-6	2-3	2-4	3-5	4-5	6-7	5-8	7-8
t_0	1	2	2	2	7	5	5	3	8
t_m	7	5	14	5	10	5	8	3	17
t_p	13	14	26	8	19	17	29	9	32

6. A department store wishes to purchases the following quantities of sarees:

Types of Sarees	A	B	C	D	E
Quantity	150	100	75	250	200

Tenders are submitted by our four different manufactures who undertake to supply not more than the quantities mentioned below:

Manufacturer	W	X	Y	Z
Total Quantity	300	250	150	200

Manufacturer	Sarees				
	A	B	C	D	E
W	275	350	425	225	150
X	300	325	450	175	100
Y	250	350	475	200	125
Z	325	275	400	250	175

Determine how should the order be placed with optimality?

7. A fertilizer company distributes its products by trucks that are loaded at its only loading station. Both, company trucks and contractor's trucks are used for this purpose. It was found that on an average, every 5 minutes one truck arrived and the average loading time was 3 minutes. Find (a) probability that a truck has to wait (b) The waiting time of a truck that waits.

8. What is the indication that LP-problem possesses the multiple optimal solution by Simplex method? by using this method find two optimal solutions of

$Maximize\ Z = 3x_1 + 3x_2$

subject to the constraints $x_1 + x_2 \leq 5\ ; x_1 + 2x_2 \leq 6\ ;\ x_1, x_2 \geq 0$ [2+2+1]

OR

Find optimal solution of the following linear programming problem by using two phase method:

Minimize $Z = 3x_1 - x_2$ Subject to $2x_1 + x_2 \geq 2\ ; x_1 + 3x_2 \leq 3; x_2 \geq 4\ ; x_1, x_2 \geq 0$

SECTION "E"

[2 Q. × 2 = 4 marks]

9. Differentiate between CPM and PERT

10. Discuss integer programming problem

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z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414
-0.1	.46017	.45620	.45224	.44828	.44433	.44034	.43640	.43251	.42858	.42465
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	19215	.18943	.18673
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-1	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08692	.08534	.08379	.08226
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-2	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-3	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-4	.00003	.00003	.00003	.00003	.00003	.00003	.00002	.00002	.00002	.00002

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
+0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
+0.1	.53983	.54380	.54776	.55172	.55567	.55966	.56360	.56749	.57142	.57535
+0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
+0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
+0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
+0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
+0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
+0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
+0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
+0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
+1	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
+1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
+1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
+1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91308	.91466	.91621	.91774
+1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
+1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
+1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
+1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
+1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
+1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
+2	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
+2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
+2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
+2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
+2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
+2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
+2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
+2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
+2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
+2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
+3	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
+3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
+3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
+3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
+3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
+3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
+3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
+3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
+3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
+3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997
+4	.99997	.99997	.99997	.99997	.99997	.99997	.99998	.99998	.99998	.99998