INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY

TUTORIAL QUESTION BANK

Course Name	:	**Optimization Techniques**
Course Code	:	AHS012
Class	:	V Semester
Branch	:	Information Technology
Year	:	2018 – 2019
Course Coordinator	:	Ms. A Soujanya, Assistant Professor, CSE

OBJECTIVES:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

S. No.	Question	Blooms Taxonomy Level	Course Learning Outcomes
	UNIT-I **Short Answer Questions**		
1	Write the scope of Operation research.	Understand	CAHS012.01
2	Write the applications of Operation research.	Understand	CAHS012.01
3	What are different characteristics of Operation research?	Remember	CAHS012.01
4	Write the history of Operation research.	Understand	CAHS012.01
5	What are the phases of Operation research?	Understand	CAHS012.01
6	Discuss about physical model of Operation research?	Remember	CAHS012.02
7	Write about Symbolic models of Operation research.	Understand	CAHS012.02
8	Discuss about deterministic models of Operation research?	Understand	CAHS012.01
9	Write about probabilistic models of Operation research.	Understand	CAHS012.02
10	Define simulation models of Operation research?	Remember	CAHS012.02
11	Write about analytical models of Operation research.	Understand	CAHS012.02
12	Write the applications of Operation research. In production management.	Remember	CAHS012.02
13	Discuss the importance of Operation research in the decision making process?	Understand	CAHS012.02
14	What is a purpose of mathematical model?	Remember	CAHS012.03
15	Define general representation of LPP?	Understand	CAHS012.03
16	What are the objective functions in brief?	Understand	CAHS012.03
17	Discuss about decision variables?	Understand	CAHS012.03
18	Write about non- negativity constraints.	Understand	CAHS012.03

19	Write about constraints of a LPP.	Understand	CAHS012.03
20	Define slack variables with examples?	Remember	CAHS012.03
21	Define surplus variables with examples?	Remember	CAHS012.02
22	Describe about artificial variables?	Understand	CAHS012.03
23	Define basic feasible solution?	Remember	CAHS012.03
24	Define optimal solution?	Remember	CAHS012.03
25	Define feasible region?	Remember	CAHS012.03
26	Define basic and non basic variables?	Remember	CAHS012.03
	Long Answer Questions		
1	What are the terminologies involved in formulating a linear programming problem?	Understand	CAHS012.02
2	Write the applications of LPP in production management and explain limitations of OR.	Understand	CAHS012.02
3	Explain what is meant by degeneracy in LPP? How can this be solved?	Understand	CAHS012.03
4	A farmer has 100 acre farm. He can sell all tomatoes, lettuce, or radishes he can raise. The price he can obtain is Rs 1.00 per kg for tomatoes, Rs 0.75 a head for lettuce and Rs 2.00 per kg for radishes. The average yield per acre is 2000 kg of tomatoes, 3000 heads of lettuce and 1000 kgs of radishes. Fertilizer is available at Rs 0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce, and 50 kgs for radishes. Labor required for sowing and harvesting per acre is 5 man-days for tomatoes and radishes, and 6 man-days for lettuce. A total of 400 man-days of labor are available at Rs 20.00 per man-day. Formulate this as a Linear-Programming model to maximize the farmer's total profit.	Understand	CAHS012.03
5	Write step-by-step procedure to solve LPP by BIG-M method?	Understand	CAHS012.03
6	Explain the algorithm of simplex method to solve an LPP?	Remember	CAHS012.03
7	Explain the structure of an LPP with examples?	Understand	CAHS012.03
8	What is an unbounded solution? Explain about infeasibility solution?	Remember	CAHS012.03
9	What are the assumptions to solve LPP using simplex?	Understand	CAHS012.03
10	Explain alternate solution of a LPP with example?	Understand	CAHS012.03
11	What are the limitations of graphical method?	Remember	CAHS012.03
12	Explain the term artificial variables? Why do we need them?	Understand	CAHS012.03
13	Solve the below LPP Maximize $z = 18x_1 + 16x_2$ subject to $15x_1 + 25x_2 \leq 375$ $24x_1 + 11x_2 \leq 264$ $x_1, x_2 \geq 0$	Understand	CAHS012.03
14	Use big –M method to solve the following Maximize Z = 8x1 + 5x2 Subjected to 2x1+4 x2 ≤ 45 3x1+2x2 ≤ 40 x1 +x2 ≥ 30 x1, x2 ≥ 0.	Understand	CAHS012.03
15	Solve the following LP Problem by two phase method Maximize Z = 5x1 - 2x2 + 3x3 Subject to 2x1 + 2x2 - x3 ≥ 2, 3x1 - 4x2 ≤ 3, x2 +3x3 ≤ 5 x1, x2 , x3 ≥ 0	Understand	CAHS012.01
	Analytical Questions		
1	Let us consider a company making single product. The estimated demand for the product for the next four months are 1000, 800, 1200, 900 respectively. The company has a regular time capacity of 800 per	Remember	CAHS012.01

	month and an overtime capacity of 200 per month. The cost of regular time production is Rs.20 per unit and the cost of overtime production is Rs.25 per unit. The company can carry inventory to the next month and theholdingcostisRs.3/unit/month the demand has to be met every month. Formulate a linear programming problem for the above situation		
2	Solve the following LP problem graphically. Maximize $z = 2x_1 + x_2$ S.T $x_1 + 2x_2 \le 10$, $x_1 + x_2 \le 6$, $x_1 - x_2 \le 2$, $x_1 - 2x_2 \le 1$ $x_1, x_2 \ge 0$	Understand	CAHS012.01
3	Solve the following LP problem using simplex method. Maximize $6x_1 + 8x_2$ S.T $x_1 + x_2 \le 10$, $2x_1 + 3x_2 \le 25$, $x_1 + 5x_2 \le 35$ $x_1, x_2 \ge 0$	Understand	CAHS012.01
4	Solve the following LPP by Big-M penalty method Minimize $z = 5x_1 + 3x_2$ S.T $2x_1 + 4x_2 \le 12$, $2x_1 + 2x_2 = 10$, $5x_1 + 2x_2 \ge 10$ and $x_1, x_2 \ge 0$	Understand	CAHS012.02
5	Solve the following LPP by two phase method Minimize $z = 3x_1 + 4x_2$ S.T $2x_1 + 3x_2 \ge 8$, $5x_1 + 2x_2 \ge 12$, $x_1, x_2 \ge 0$	Remember	CAHS012.01
6	A firm produces three types of biscuits A, B, C it packs them in arrestments of two sizes 1 and 11. The size 1 contains 20 biscuits of type A, 50 of type B and 10 of type C. the size 11 contains 10 biscuits of the A, 80 of type B and 60 of type C. A buyer intends to buy at least 120 biscuits of type A, 740 of type B and 240 of type C. Determine the least number of packets he should buy.	Remember	CAHS012.02
7	Solve the following LP problem by two phase method. Maximize $z = 5x_1 + 8x_2$ S.T $3x_1 + 2x_2 \ge 3$ $x_1 + 4x_2 \ge 0$ $4x_1 + x_2 \le 0$ $5x_1 + x_2 \ge 0$	Understand	CAHS012.01
8	Solve the following LP problem graphically Maximize $z = -x_1 + 2x_2$ S.T $x_1 - x_2 \le -1$, $-0.5x_1 - x_2 \le 2$, $x_1, x_2 \ge 0$	Understand	CAHS012.02

UNIT – II
Short Answer Questions

S. No.	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Define mathematical model of a transportation problem?	Understand	CAHS012.04
2	What are different methods of solving transportation problems to get Basic feasible solution?	Remember	CAHS012.04
3	Why is LCM is optimal than NWCR in solving transportation problem?	Understand	CAHS012.04
4	Why does Vogel's approximation method provide a good initial feasible solution?	Remember	CAHS012.05
5	What are the methods to test for optimality in transportation problem?	Remember	CAHS012.04

6	What is degeneracy in transportation problem?	Remember	CAHS012.04
7	Write the travelling sales man problem.	Understand	CAHS012.05
8	What is unbalance problem in transportation?	Understand	CAHS012.04
9	Write the balanced problem in transportation.	Understand	CAHS012.04
10	Define constraints of a transportation problem?	Understand	CAHS012.04
11	What is assignment problem?	Remember	CAHS012.05
12	List out the applications of assignment problem?	Understand	CAHS012.05
13	Give the mathematical representation of an assignment problem	Understand	CAHS012.05
14	What is the difference between assignment problem and travelling salesman problem?	Remember	CAHS012.05
15	Discuss the method of solving assignment problems?	Understand	CAHS012.05
16	Show that an assignment problem is a special case of a transportation problem?	Understand	CAHS012.06
17	Describe an algorithm to solve an assignment problem?	Understand	CAHS012.06
18	What is Hungarian method?	Remember	CAHS012.06
19	Write the unbalanced assignment problem.	Understand	CAHS012.06
Long Answer Questions			
1	Explain mathematical model of a transportation problem?	Understand	CAHS012.04
2	What are different methods of solving transportation problems to get basic feasible solution?	Remember	CAHS012.04
3	Why is LCM is optimal than NWCR in solving transportation problem?	Understand	CAHS012.04
4	Why does Vogel's approximation method provide a good initial feasible solution?	Remember	CAHS012.04
5	What are the methods to test for optimality in transportation problem?	Remember	CAHS012.05
6	What is degeneracy in transportation problem?	Remember	CAHS012.05
7	Write the travelling sales man problem?	Understand	CAHS012.05
8	Explain unbalance problem in transportation?	Understand	CAHS012.05
9	Write the balanced problem in transportation?	Understand	CAHS012.05
10	Explain constraints of a transportation problem?	Understand	CAHS012.05
11	What is assignment problem?	Remember	CAHS012.05
12	Explain applications of assignment problem?	Understand	CAHS012.05
13	Give the mathematical representation of an assignment problem	Understand	CAHS012.05
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16	Show that an assignment problem is a special case of a transportation problem?	Understand	CAHS012.06
17	Explain an algorithm to solve an assignment problem?	Understand	CAHS012.06
18	What is Hungarian method?	Remember	CAHS012.06
19	Write the unbalanced assignment problem?	Understand	CAHS012.06
Analytical Questions			
1	A Company has three plants at locations A,B and C which supply to warehouses located at D,E,F,G and H. monthly plant capacities are 800,500and900respectively.Monthly warehouse requirements are400,500,400and800unitsrespectively.Unittransportation cost in rupees are given below. | | D | E | F | G | H | | A | 5 | 8 | 6 | 6 | 3 | | B | 4 | 7 | 7 | 6 | 5 | | C | 8 | 4 | 6 | 6 | 4 | Determine an optimum distribution for the company in order to minimize the total transportation cost by NWCR.	Understand	CAHS012.04
2	A company has factories at F_1, F_2 and F_3 that supply products to	Understand	CAHS012.04

<table>
<tr><td></td><td>ware houses at W_1, W_2 and W_3 .The weekly capacities of the factories are 200,160 and 90 units. The weekly warehouse requirements are 180,120 and 150/units respectively. The unit shipping costs in rupees are as follows. Find the optimal solution
<table>
<tr><td></td><td>W_1</td><td>W_2</td><td>W_3</td><td>Sup ply</td></tr>
<tr><td>F1</td><td>16</td><td>20</td><td>12</td><td>200</td></tr>
<tr><td>F2</td><td>14</td><td>8</td><td>18</td><td>160</td></tr>
<tr><td>F3</td><td>26</td><td>24</td><td>16</td><td>90</td></tr>
<tr><td>Demand</td><td>180</td><td>120</td><td>150</td><td>450</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>3</td><td>Solve the following assignment problem to minimize the total time of the operator
<table>
<tr><td colspan="6">Jobs</td></tr>
<tr><td>Operator</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>1</td><td>6</td><td>2</td><td>5</td><td>2</td><td>6</td></tr>
<tr><td>2</td><td>2</td><td>5</td><td>8</td><td>7</td><td>7</td></tr>
<tr><td>3</td><td>7</td><td>8</td><td>6</td><td>9</td><td>8</td></tr>
<tr><td>4</td><td>6</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>5</td><td>9</td><td>3</td><td>8</td><td>9</td><td>7</td></tr>
<tr><td>6</td><td>4</td><td>7</td><td>4</td><td>6</td><td>8</td></tr>
</table></td><td>Remember</td><td>CAHS012.04</td></tr>
<tr><td>4</td><td>Different machines can do any of the five required jobs, with different profits resulting from each assignment as shown in the adjusting table. Find out maximum profit possible through optimal assignment.
<table>
<tr><td>Jobs</td><td colspan="5">Machines</td></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr>
<tr><td>1</td><td>30</td><td>37</td><td>40</td><td>28</td><td>40</td></tr>
<tr><td>2</td><td>40</td><td>24</td><td>27</td><td>21</td><td>36</td></tr>
<tr><td>3</td><td>40</td><td>32</td><td>33</td><td>30</td><td>35</td></tr>
<tr><td>4</td><td>25</td><td>38</td><td>40</td><td>36</td><td>36</td></tr>
<tr><td>5</td><td>29</td><td>62</td><td>41</td><td>34</td><td>39</td></tr>
</table></td><td>Understand</td><td>CAHS012.05</td></tr>
<tr><td>5</td><td>A typical assignment problem, presented in the classic manner. Here there are five machines to be assigned to five jobs. The numbers in the matrix indicate the cost of doing each job with each machine. Jobs with costs of M are disallowed assignments. The problem is to find the minimum cost matching of machines to jobs.
<table>
<tr><td></td><td>J1</td><td>J2</td><td>J3</td><td>J4</td><td>J5</td></tr>
<tr><td>M1</td><td>M</td><td>8</td><td>6</td><td>12</td><td>1</td></tr>
<tr><td>M2</td><td>15</td><td>12</td><td>7</td><td>M</td><td>10</td></tr>
<tr><td>M3</td><td>10</td><td>M</td><td>5</td><td>14</td><td>M</td></tr>
<tr><td>M4</td><td>12</td><td>M</td><td>12</td><td>16</td><td>15</td></tr>
<tr><td>M5</td><td>18</td><td>17</td><td>14</td><td>M</td><td>13</td></tr>
</table></td><td>Understand</td><td>CAHS012.05</td></tr>
<tr><td>6</td><td>A salesman has to visit five cities A, B, C, D, E. The intercity distances are tabulated below.
<table>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>A</td><td>-</td><td>12</td><td>24</td><td>25</td></tr>
<tr><td>B</td><td>6</td><td>-</td><td>16</td><td>18</td></tr>
<tr><td>C</td><td>10</td><td>11</td><td>-</td><td>18</td></tr>
<tr><td>D</td><td>14</td><td>17</td><td>22</td><td>-</td></tr>
<tr><td>E</td><td>12</td><td>13</td><td>23</td><td>25</td></tr>
</table>
Find the shortest route covering all the cities.</td><td>Understand</td><td>CAHS012.05</td></tr>
<tr><td>7</td><td>The assignment cost of assigning any one operator to any one machine is given in the following table.</td><td>Understand</td><td>CAHS012.06</td></tr>
</table>

	Machine / Operators: Machine | I | II | III | IV A | 10 | 5 | 13 | 15 B | 3 | 9 | 18 | 3 C | 10 | 7 | 3 | 2 D | 5 | 11 | 9 | 7 Solve the optimal assignment by Hungarian method.		
8	The profit after assigning the machines to jobs is given as follows. Solve the problem to maximize the profits | | J1 | J2 | J3 | J4 | J5 | J6 | M1 | 5 | 3 | 7 | 6 | 5 | 3 | M2 | 7 | 6 | 1 | 4 | 2 | 8 | M3 | 6 | 2 | 4 | 3 | 4 | 5 | M4 | 4 | 6 | 4 | 7 | 3 | 8 |	Remember	CAHS012.06
9	Explain the algorithm for solving transportation problem by Vogel's approximation rule? With example?	Understand	CAHS012.05
10	Solve the following transportation problem. | | A | B | C | D | Supply | I | 9 | 16 | 15 | 6 | 15 | II | 2 | 1 | 3 | 5 | 25 | III | 6 | 4 | 7 | 3 | 20 | Demand | 10 | 15 | 25 | 10 |	Understand	CAHS012.06
	UNIT – III **Short Answer Questions**		
1	What are different types of sequencing problems?	Understand	CAHS012.07
2	Write the general representation of sequencing.	Remember	CAHS012.07
3	What are applications of sequencing?	Understand	CAHS012.07
4	Write the terminology of sequencing techniques in operations research.	Understand	CAHS012.07
5	What is the advantage of a mixed strategy over a pure strategy?	Understand	CAHS012.07
6	What are the conditions to be satisfied to convert a 'n' jobs 3 machine problem into 'n' jobs 2 machine problem? Explain the method clearly?	Remember	CAHS012.08
7	Write short note on sequencing.	Remember	CAHS012.08
8	Describe various sequencing models?	Remember	CAHS012.08
9	What are the assumptions made in sequencing problem?	Understand	CAHS012.08
10	Define a pure strategy?	Remember	CAHS012.08
11	Define a mixed strategy?	Understand	CAHS012.08
12	Give the justification of Johnson's rule for sequencing n jobs x 2 machines?	Understand	CAHS012.08
13	Define a two-person zero-sum game?	Understand	CAHS012.09
14	Define n-person zero-sum game?	Understand	CAHS012.09
15	What is a rectangular game?	Understand	CAHS012.09
16	Define a strategy?	Remember	CAHS012.09
17	What are the characteristics of a two-person zero-sum game?	Understand	CAHS012.09
18	State the rules for a game theory?	Understand	CAHS012.09
	Long Answer Questions		
1.	Write the importance of replacement analysis.	Remember	CAHS012.07
2.	Explain with examples the failure mechanism of items.	Understand	CAHS012.07

	<table><tr><td rowspan="2">Machine</td><td colspan="5">Operators</td></tr><tr><td></td><td>I</td><td>II</td><td>III</td><td>IV</td></tr><tr><td></td><td>A</td><td>10</td><td>5</td><td>13</td><td>15</td></tr><tr><td></td><td>B</td><td>3</td><td>9</td><td>18</td><td>3</td></tr><tr><td></td><td>C</td><td>10</td><td>7</td><td>3</td><td>2</td></tr><tr><td></td><td>D</td><td>5</td><td>11</td><td>9</td><td>7</td></tr></table>		
3.	Write about 'replacement policy of items which deteriorate with time.	Understand	CAHS012.08
4.	Derive the expression for the average annual cost of an item over a period of 'n' years, when the money value remains constant.	Remember	CAHS012.09
5.	Discuss the policy of replacement of items whose maintenance cost increases with time but the value of money remains constant during the period.	Understand	CAHS012.09
6.	Write how replacement problems are classified?	Remember	CAHS012.09
7.	Explain the difference between age replacement and preventive maintenance.	Understand	CAHS012.10
8.	Calculate the following sequencing problem to minimize the time elapsed with sequence <table><tr><td colspan="6">M & M2</td></tr><tr><td>Job</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Machine M1</td><td>7</td><td>10</td><td>8</td><td>9</td><td>7</td></tr><tr><td>Machine M2</td><td>2</td><td>1</td><td>4</td><td>0</td><td>5</td></tr></table>Also find the total elapsed time and idle times of each machine.	Remember	CAHS012.10
9.	Determine the best sequence for '5' jobs that will minimize the elapsed time T, if each of the '5' jobs must go through machines A, B and C in the order ABC, The processing times are. <table><tr><td>Job</td><td colspan="3">Processing time</td></tr><tr><td></td><td>A</td><td>B</td><td>C</td></tr><tr><td>1</td><td>8</td><td>5</td><td>4</td></tr><tr><td>2</td><td>10</td><td>6</td><td>9</td></tr><tr><td>3</td><td>6</td><td>2</td><td>8</td></tr><tr><td>4</td><td>7</td><td>3</td><td>6</td></tr><tr><td>5</td><td>11</td><td>4</td><td>5</td></tr></table>	Understand	CAHS012.11
10.	A book binder has one printing press, one binding machine and manuscripts of 7 different books. The time required for performing printing and binding operations for different books are shown below. <table><tr><td>Book</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>Printing Time (hr)</td><td>20</td><td>90</td><td>80</td><td>20</td><td>120</td><td>15</td><td>65</td></tr><tr><td>Binding Time (hrs)</td><td>25</td><td>60</td><td>75</td><td>30</td><td>90</td><td>35</td><td>50</td></tr></table>Decide the optimum sequence of processing of books in order to minimize the total time required to bring out all the books.	Understand	CAHS012.11
11.	Solve the following sequence problem, given an optimal solution when passing is not allowed. <table><tr><td rowspan="2">Machines</td><td colspan="5">Jobs</td></tr><tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr><tr><td>M1</td><td>11</td><td>13</td><td>9</td><td>16</td><td>17</td></tr><tr><td>M2</td><td>4</td><td>3</td><td>5</td><td>2</td><td>6</td></tr><tr><td>M3</td><td>6</td><td>7</td><td>5</td><td>8</td><td>4</td></tr><tr><td>M4</td><td>15</td><td>8</td><td>13</td><td>9</td><td>11</td></tr></table>	Remember	CAHS012.09

<table>
<tr><td>12.</td><td>Six jobs go first on machine A, then on machine B and last on machine C. The order of completion of jobs has no significance. The following table gives machine time for the six jobs and the three machines. Find the sequence of jobs that minimizes elapsed time to complete the jobs.
<table>
<tr><td rowspan="2">Jobs</td><td colspan="3">Processing Time</td></tr>
<tr><td>Machine A</td><td>Machine B</td><td>Machine C</td></tr>
<tr><td>1</td><td>8</td><td>3</td><td>8</td></tr>
<tr><td>2</td><td>3</td><td>4</td><td>7</td></tr>
<tr><td>3</td><td>7</td><td>5</td><td>6</td></tr>
<tr><td>4</td><td>2</td><td>2</td><td>9</td></tr>
<tr><td>5</td><td>5</td><td>1</td><td>10</td></tr>
<tr><td>6</td><td>1</td><td>6</td><td>9</td></tr>
</table></td><td>Understand</td><td>CAHS012.10</td></tr>
<tr><td colspan="4">Analytical Questions</td></tr>
<tr><td>1</td><td>Machine A costs of Rs: 80,000. Annually operating cost are Rs: 2,000 for the first years and they increase by Rs: 15,000 every years (for example in the fourth year the operating cost are Rs: 47,000).Determine the least age at which to replace the machine. If the optional replacement policy is followed.
a) What will be the average yearly cost of operating and owing the machine (Assume that the reset value of the machine is zero when replaced, and that future costs are not discounted.
b) Another machine B cost Rs: 1, 00,000. Annual operating cost for the first year is Rs: 4,000 and they increase by Rs: 7,000 every year .The following firm has a machine of type A which is one year old. Should the firm replace it with B and if so when?
c) Suppose the firm is just ready to replace the M/c A with another M/c of the same type, just the firm gets an information that the M/c B will become available in a year .What should firm do?</td><td>Remember</td><td>CAHS012.07</td></tr>
<tr><td>2</td><td>Machine A costs Rs: 45,000 and its operating costs are estimated to be Rs: 1,000 for the first year increasing by Rs: 10,000 per year in the second year and subsequent years .Machine B costs Rs: 50,000 and operating cost are Rs: 2,000 for the first year and increasing by Rs: 4,000 in the second and subsequent years. If at present we have a machine of type A, should we replace it with B? If so when? Assume both machines have no resale value and these future costs are not discounted?</td><td>Understand</td><td>CAHS012.11</td></tr>
<tr><td>3</td><td>The data collected in running a Machine the cost of which is Rs:60,000 are given below
<table>
<tr><td>Resale value</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Resale value (Rs)</td><td>42,000</td><td>30,000</td><td>20,400</td><td>14,400</td><td>9,650</td></tr>
<tr><td>Cost of Spares (Rs)</td><td>4,000</td><td>4,270</td><td>4,880</td><td>5,700</td><td>6,800</td></tr>
<tr><td>Cost of Labor</td><td>14,000</td><td>16,000</td><td>18,000</td><td>21,000</td><td>25,000</td></tr>
</table></td><td>Remember</td><td>CAHS012.11</td></tr>
<tr><td>4</td><td>Let the value of the money be assumed be 10% per year and suppose that the machine A is replaced after every three years whereas machine B is replaced every six years .The yearly cost in(Rs) of both the machines are given below. Determine which Machine should be purchased?
<table>
<tr><td>Year</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Machine A</td><td>1000</td><td>200</td><td>400</td><td>1000</td><td>200</td><td>400</td></tr>
<tr><td>Machine B</td><td>1700</td><td>100</td><td>200</td><td>300</td><td>400</td><td>500</td></tr>
</table></td><td>Understand</td><td>CAHS012.11</td></tr>
</table>

<table>
<tr><td>5</td><td>The management of a large hotel is considering the periodic replacement of light bulbs fitted in it's room .There are 500 rooms in the hotel and each room has 6 bulbs. The management is now following the policy of replacing the bulbs as they fail at the total cost of Rs:3 per bulb .The management feels that this cost can be reduced to Rs:1 by adopting the group replacement method. On the basis of the information given below, evaluate the alternative and make a recommendation to the management.
<table>
<tr><td>Month of use</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Percent of bulbs failing by that month</td><td>10</td><td>25</td><td>50</td><td>80</td><td>100</td></tr>
</table></td><td>Remember</td><td>CAHS012.12</td></tr>
<tr><td>6</td><td>A firm is considering the replacement of a machine, whose cost price is Rs.12, 200 and its shop value is Rs.200. From experience the running (maintenance and operating) costs are found to be as follows.
<table>
<tr><td>Year</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>Running Cost</td><td>200</td><td>500</td><td>800</td><td>1200</td><td>1800</td><td>2500</td><td>3200</td><td>4000</td></tr>
</table></td><td>Understand</td><td>CAHS012.12</td></tr>
<tr><td>7</td><td>Obtain the optimal strategies for both pensions and the value of the game for two persons zero sum game whose payoff matrix is as follows
<table>
<tr><td rowspan="8">Player -A</td><td colspan="3">Player- B</td></tr>
<tr><td></td><td>B1</td><td>B2</td></tr>
<tr><td>A1</td><td>1</td><td>-3</td></tr>
<tr><td>A2</td><td>3</td><td>5</td></tr>
<tr><td>A3</td><td>-1</td><td>6</td></tr>
<tr><td>A4</td><td>4</td><td>1</td></tr>
<tr><td>A5</td><td>2</td><td>2</td></tr>
<tr><td>A6</td><td>-5</td><td>0</td></tr>
</table></td><td>Understand</td><td>CAHS012.12</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>8</td><td>The production department of a company required 3,600kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs.36 and the cost of carrying inventory is 25% of the investment in the inventories, the price is Rs.10/kg. help the purchase manager to determine and ordering policy for raw material, determine Optimal lot size.</td><td>Remember</td><td>CAHS012.12</td></tr>
<tr><td>9</td><td>Purchase manager places order each time for a lot of 500 no of particular item from the available data the following results are obtained, inventory carrying 40%, ordering cost order Rs.600, cost per unit Rs.50 annual demand 1000, find out the loser to the organization due to his policy.</td><td>Understand</td><td>CAHS012.12</td></tr>
<tr><td>10</td><td>A dealer supplies you the following information with regards to a product that he deals in annual demand =10,000 units, ordering cost Rs.10/order, Price Rs.20/unit. Inventory carrying cost is 20% of the value of inventory per year. The dealer is considering the possibility of allowing some back orders to occur. He has estimated that the annual cost of back ordering will be 25% of the value of inventory.
a. What should be the optimum no of units he should buy in 1 lot?
b. What qty of the product should be allowed to be backordered
c. What would be the max qty of inventory at any time of year
d. Would you recommend allowing backordering? If so what would be the annual cost saving by adopting the policy of back ordering.</td><td>Remember</td><td>CAHS012.12</td></tr>
<tr><td>11</td><td>The annual demand of a product is 10,000 units. Each unit costs Rs.100 if the orders are placed in quantities below 200 units. for orders above 200 or above, however the price is Rs.95. The annual inventory holding costs is 10% of the value of the item and the ordering costs is Rs.5/order. Find economic lot size?</td><td>Understand</td><td>CAHS012.12</td></tr>
</table>

UNIT – IV
Short Answer Questions

S. No.	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Define dynamic programming?	Remember	CAHS012.13
2	Who developed the technique called dynamic programming?	Remember	CAHS012.13
3	Define state and stage?	Remember	CAHS012.13
4	Define state variable and decision variable?	Remember	CAHS012.13
5	What is immediate and optimal return?	Remember	CAHS012.14
6	State Bellman's principle of optimality?	Remember	CAHS012.14
7	What are the applications of dynamic programming?	Understand	CAHS012.15
8	State the examples of dynamic programming?	Understand	CAHS012.14
9	Define dynamic programming shortest path problem?	Understand	CAHS012.16
10	What are the requirements of quantitative methods?	Remember	CAHS012.16
	Long Answer Questions		
1	Discuss dynamic programming with suitable examples	Understand	CAHS012.13
2	Minimize $z = y_1^2 + y_2^2 + y_3^2$, S.T $y_1 + y_2 + y_3 = 10$, y_1, y_2, y_3 Solve by using Bellman's principle.	Understand	CAHS012.13
3	Use dynamic programming to solve the following problem Maximize $z = x_1^2 + 2x_2^2 + 4x_3^2$, S.T $x_1 + 2x_2 + x_3$ 8, x_1, x_2, x_3	Understand	CAHS012.13
4	A vessel is to be loaded with stocks of 3 items. Each item '*i*' has a weight of w_i and a value of v_i. The maximum cargo weight the vessel can take is 5 and the details of the three items are as follows: J | WJ | VJ 1 | 1 | 30 2 | 3 | 80 3 | 2 | 65 Develop the recursive equation for the above case and find the most valuable cargo load without exceeding the maximum cargo weight by using dynamic programming?	Understand	CAHS012.13
5	Minimize $a^2 + b^2 + c^2$, subject to $a + b + c = 10$ when *(i)* *a, b, c* are non-negative, *(ii)* *a, b, c* are non-negative integers?	Understand	CAHS012.14
6	A manufacturing firm has a contract to supply lathe chucks as per the following schedule. The product made during a month will be supplied at the end of the month. The setup cost is Rs. 1000/-, while the inventory carrying cost is Re. 1/- per piece per month. In which month should the batches be produced and of what size, so that the total of setup and inventory carrying cost are minimized? Month | Number of items January | 100 February | 200 March | 300 April | 400 May | 400 June | 300	Understand	CAHS012.14

<table>
<tr><td>7</td><td>Solve the following Linear Programming (L.P.) problem using Dynamic Programming (D.P.) technique.
Maximize $5x + 9y$ subject to
$-x + 3y >= 3$,
$5x + 3y >= 27$ and both x and y are $>= 0$.</td><td>Understand</td><td>CAHS012.14</td></tr>
<tr><td>8</td><td>Minimize $Z = a^2 + b^2 + c^2$ subject to
$a + b + c >= 15$ and all a, b, c are $>= 0$</td><td>Understand</td><td>CAHS012.15</td></tr>
<tr><td colspan="4">Analytical Questions</td></tr>
<tr><td>1</td><td>In a cargo-loading problem, there are four items of different weight per unit and value as shown below. The maximum cargo load is restricted to 17 units. How many units of each item is loaded to maximize the value?
<table>
<tr><th>Item (i)</th><th>Weight (w1)</th><th>Value (v1)</th></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>3</td><td>5</td></tr>
<tr><td>3</td><td>4</td><td>7</td></tr>
<tr><td>4</td><td>6</td><td>11</td></tr>
</table></td><td>Understand</td><td>CAHS012.15</td></tr>
<tr><td>2</td><td>Maximize $Z = 50x + 80y$ s.t.
$X>80$, $y>60$ and $5x + 6y >600$,
$x + 2y >160$ and both x and y are $>=0$</td><td>Understand</td><td>CAHS012.15</td></tr>
<tr><td>3</td><td>Solve the given L.P. Model by using dynamic programming technique.
Max $Z = a = 9b$ s.t. $2a + 1b >= 25$, $0a + 1b >= 11$ and both a and b are$>=0$.</td><td>Understand</td><td>CAHS012.16</td></tr>
<tr><td>4</td><td>Solve the following LP problem by dynamic programming:
Maximize f (x1, x2) = 10x1 + 8x2
subject to
$2x1 + x2 \leq 25$
$3x1 + 2x2 \leq 45$
$x2 \leq 10$
$x1 \geq 0, x2 \geq 0$
Verify your solution by solving it graphically.</td><td>Understand</td><td>CAHS012.16</td></tr>
<tr><td>5</td><td>Solve the following LP problem by dynamic programming:
Minimize
$f(x1, x2) = (50x1 + 0.2x21) + (50x2 + 0.2x22) + 8(x1 - 80)$
subject to
$x1 \geq 80$
$x1 + x2 = 200$
$x1 \geq 0, x2 \geq 0$</td><td>Understand</td><td>CAHS012.16</td></tr>
<tr><td colspan="4">UNIT – V
Short Answer Questions</td></tr>
<tr><td>1</td><td>Define quadratic approximation?</td><td>Understand</td><td>CAHS012.19</td></tr>
<tr><td>2</td><td>Write short notes on nonlinear programming?</td><td>Understand</td><td>CAHS012.19</td></tr>
<tr><td>3</td><td>What are methods for constrained problems?</td><td>Understand</td><td>CAHS012.19</td></tr>
<tr><td>4</td><td>Write short notes on lengrangian function?</td><td>Understand</td><td>CAHS012.19</td></tr>
<tr><td>5</td><td>What is variable constraints method?</td><td>Remember</td><td>CAHS012.20</td></tr>
<tr><td>6</td><td>Write short note on direct quadratic approximation?</td><td>Remember</td><td>CAHS012.20</td></tr>
<tr><td>7</td><td>Describe quadratic objective function?</td><td>Remember</td><td>CAHS012.20</td></tr>
<tr><td>8</td><td>What is a quadratic inequality constraint?</td><td>Remember</td><td>CAHS012.20</td></tr>
<tr><td>9</td><td>Write short notes on quadratic approximation of the Legrangian function?</td><td>Remember</td><td>CAHS012.21</td></tr>
<tr><td>10</td><td>Write short notes on variable metric methods for constrained optimization?</td><td>Remember</td><td>CAHS012.21</td></tr>
</table>

Long Answer Questions			
1	What is the major disadvantage associate with a solution technique based upon direct use of full quadratic approximations to all functions in the nonlinear program?	Understand	CAHS012.19
2	Outline an implementation of a successive Lagrangian QP algorithm that would employ the more conservative step adjustment strategy of the Griffith and Stewart SLP algorithm. Discuss the advantages and disadvantages relative to the penalty function strategy?	Understand	CAHS012.19
3	Compare the treatment of inequality constraints in the GRG and CVM algorithms. How do the methods of estimating multiplier values differ?	Understand	CAHS012.19
4	Solve the problem Minimize $f(x) = 6x_1 x_2^{-1} + x_2 x_1^{-2}$ Subjectto $h(x)=x_1x_2-2=0$ $g(x) = x_1 + x_2 - 1 >=0$ From the initial feasible estimate $x^0 = (2, 1)$ using the direct successive quadratic programming (QP) strategy?	Understand	CAHS012.20
5	Explain the Direct Successive Quadratic Programming Solution?	Understand	CAHS012.20
6	What is quadratic approximation of the Legrangian function? Give one example?	Remember	CAHS012.21
7	Explain the Constrained Variable Metric Method?	Understand	CAHS012.21
8	Construct a full quadratic approximation to the problem Minimize $f(x) = x_1 + x_2^2 + x_3^3$ Subject to $g_1(x) = 1 - 64x_1^{-2} x_2^{-4} x_3^{-6} >=0$ and $x_i>=0$ at the point $(\frac{1}{2}\frac{1}{2}\frac{1}{2})$.Is the resulting problem a convexproblem?	Understand	CAHS012.22
9	Suppose the CVM algorithm were employed with a problem involving a quadratic objective function and quadratic inequality constraints. How much iteration is likely to be required to solve the problem, assuming exact arithmetic? What assumptions about the problem are likely to be necessary in making this estimate?	Understand	CAHS012.22
Analytical Questions			
1	Consider the NLP Minimize $f(x) = x_1^{-1} + x_2^{-1}$ Subject to $h(x)=x_1^2+x_2^2-1=0$ $x_1, x_2 >=0$ a) Construct a full quadratic approximation to the problem at the point $x^0=(\frac{3}{4}, \frac{3}{4})$. *b)* Solve the resulting sub problem for the correction vector d and set x1= $x^0 + d$. c) Is the resulting point an improvement over x^0? How might it be further improved?	Understand	CAHS012.20
2	Consider the problem Minimize $f(x)=\frac{1}{3}(x_1+3)^3+x_2^2$ Subject to $h(x) = x^3 - x_2 + 1=0$ *and* $x_1>=1$ a) Given the point $x^0 = (2, 1)$, construct the initial sub problem for the CVM algorithm. b) Solve the sub problem to obtain. c) Calculate the step length using Powell's procedure and	Understand	CAHS012.20

	calculate the next point. d) Construct the next sub problem of the CVM method		
3	Given the problem Minimize $f(x) = 3x_1^2 - 4x_2$ Subject to $h(x)=2x_1+x_2-4=0$ $g(x) = 37 - x_1^2-x_2^2 >=0$ the point $x^0=(-1,6)$, and the multiplier values$(v,u)=(-\frac{40}{13},\frac{1}{13})$ a) Formulate the Legrangian quadratic programming (QP) sub problem. b) Show that $d=0$ is the sub problem solution. c) Show that the point satisfies the second-order conditions for the original problem	Understand	CAHS012.21
4	Solve the following LP problem using the branch-and-bound method: Maximize f = 3x1 + 4x2 subject to 7x1 + 11x2 ≤ 88, 3x1 − x2 ≤ 12, x1 ≥ 0, x2 ≥ 0 xi = integer, i = 1, 2	Understand	CAHS012.21
5	Maximize f = 4x1 + 2x2 + 3x3 + c4x4 subject to x1 + x3 + x4 ≤ 24 3x1 + x2 + 2x3 + 4x4 ≤ 48 2x1 + 2x2 + 3x3 + 2x4 ≤ 36 xi ≥ 0, i = 1 to 4 Where c4 is a discrete random variable that can take values of 4, 5, 6, or 7 with probabilities of 0.1, 0.2, 0.3, and 0.4, respectively. Using Legrangian quadratic programming (QP method, find the solution that maximizes the expected value off)	Understand	CAHS012.22

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HOD, IT