

Name:

Enrolment No:

UPES SAP ID:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End semester Examination, DEC, 2021

Course: Operation Research

Program: B.Tech (Mechanical)

Course Code: MECH4008P

No. of Pages: 02

Semester: VII

Time: 3 hours

Max. Marks: 100

Note:

1. The paper consists of 3 sections A, B and C.
2. For Section A, type your answers in the browser directly
3. For Sections B and C, scan and upload your answers.

Section A (Attempt All of the following)

Q1.	<p>1. In the optimal simplex table $c_j - z_j = 0$ value indicates (a) unbounded solution (b) cycling (c) alternative solution (d) None of these</p> <p>2. The production manager will not recommend group replacement policy (a) When large number of identical items are to be replaced, (b) In case Low cost items are to be replaced, where record keeping is a problem, (c) For items that fail completely, (d) For Repairable items.</p> <p>3. The slack variables indicate (a) Excess resource available, (b) Shortage of resource available, (c) Nil resources, (d) Idle resource.</p> <p>4. A variable which does not appear in the basis variable column of simplex table is a. never equal to zero (b) always equal to zero (c) called basic variable. (d) None of these</p>	4	CO1
Q2.	<p>True or false</p> <p>a. Linear programming models have an objective function to be maximized but not minimized.</p> <p>b. The graphical approach to the solution of linear programming problems is a very efficient means of solving problems.</p> <p>c. Slack variables are only associated with maximization problems.</p> <p>d. Surplus variables are only associated with minimization problems.</p>	4	CO1
Q3.	<p>1. Define slack variables.</p> <p>2. When is Big M method useful?</p>	4	CO1

Q4.	<p>1. The graphical method can only be used when there are _____ decision variables.</p> <p>2. The term _____ implies that one or more variables in the solution and the profit can be infinitely large.</p> <p>3. When the slope of the objective function is the same as the slope of one or more constraints, we may have _____.</p> <p>4. To find the optimal solution to an LP problem when using the graphical method, we must first identify the _____.</p>	4	CO1															
Q5.	<p>The matrix given below illustrates a game, where competitors <i>A</i> and <i>B</i> are assumed to be equal in ability and intelligence. <i>A</i> has a choice of strategy 1 or strategy 2, while <i>B</i> can select strategy 3 or strategy 4. Find the value of the game.</p> <div style="text-align: center; margin: 20px 0;"> <table style="border-collapse: collapse;"> <tr> <td colspan="2"></td> <td colspan="2" style="padding: 0 10px;"><i>B</i></td> </tr> <tr> <td colspan="2"></td> <td style="padding: 0 5px;">3</td> <td style="padding: 0 5px;">4</td> </tr> <tr> <td rowspan="2" style="padding-right: 10px;"><i>A</i></td> <td style="padding-right: 5px;">1</td> <td style="border-left: 1px solid black; border-top: 1px solid black; padding: 5px;">+4</td> <td style="border-top: 1px solid black; padding: 5px;">+6</td> </tr> <tr> <td style="padding-right: 5px;">2</td> <td style="border-left: 1px solid black; padding: 5px;">+3</td> <td style="padding: 5px;">+5</td> </tr> </table> </div>			<i>B</i>				3	4	<i>A</i>	1	+4	+6	2	+3	+5	4	CO3
		<i>B</i>																
		3	4															
<i>A</i>	1	+4	+6															
	2	+3	+5															
Section B (Attempt any four of the following)																		
Q6.	<p>In a departmental store one cashier is there to serve the customers. And the customers pick up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming Poisson arrival rate and exponential distribution for service rate, find:</p> <p>(a) Average number of customers in the system.</p> <p>(b) Average number of customers in the queue or average queue length.</p> <p>(c) Average time a customer spends in the system.</p> <p>(d) Average time a customer waits before being served.</p>	10	CO3															
Q7	<p>Solve by simplex method:</p> <p>Max $z = 3x_1 + 5x_2 + 4x_3$</p> <p>Subject to</p> <p>$2x_1 + 3x_2 \leq 8$</p> <p>$2x_2 + 5x_3 \leq 10$</p> <p>$3x_1 + 2x_2 + 4x_3 \leq 15$</p> <p>$x_1, x_2, x_3 \geq 0$</p>	10	CO2															

10

CO3

There are seven activities in a project and the time estimates are as follows

Activities	Time in weeks		
	t_0	t_L	t_P
A	2	6	10
B	4	6	12
C	2	3	4
D	2	4	6
E	3	6	9
F	6	10	14
G	1	3	5

The logical of activities are:

1. Activities A and B start at the beginning of the project.
2. When A is completed C and D start.
3. E can start when B and D are finished.
4. F can start when B, C and D are completed and is the final activity.
5. G can start when F is finished and is final activity the.

(a) What is the expected time of the duration of the project?

(b) What is the probability that project will be completed in 22 weeks?

OR

Five jobs are to be assigned to 5 machines to minimize the total time required to process the jobs on machines. The times in hours for processing each job on each machine are given in the matrix below. By using assignment algorithm make the assignment for minimizing the time of processing.

Machines (time in hours)

Jobs	V	W	X	Y	Z
A	2	4	3	5	4
B	7	4	6	8	4
C	2	9	8	10	4
D	8	6	12	7	4
E	2	8	5	8	8

Q9

A city corporation has decided to carry out road repairs on main four arteries of the city. The government has agreed to make a special grant of Rs 50 lakh towards the cost with a condition that repairs are done at the lowest cost and quickest time. If the conditions warrant, a supplementary token grant will also be considered favorably. The corporation has floated tenders and five contractors have sent in their bids. In order to expedite work, one road will be awarded to only one contractor.

Contractors	R1	R2	R3	R4	R5
C1	9	14	19	15	13
C2	7	17	20	19	18
C3	9	18	21	18	17
C4	10	12	18	19	18
C5	10	15	21	16	15

10

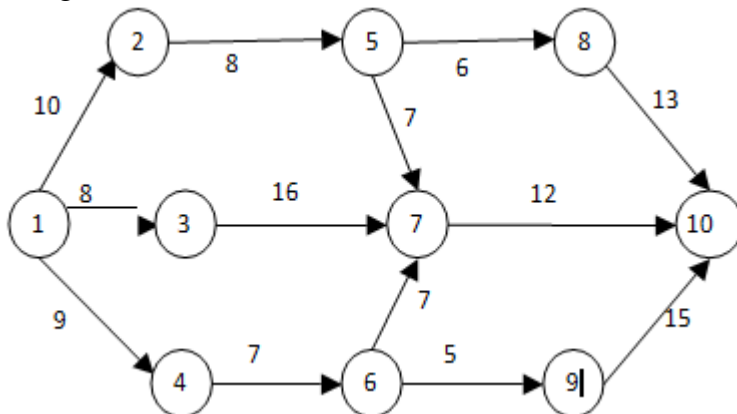
CO2

Find the best way of assigning the repair work to the contractors and the costs.
If it is necessary to seek supplementary grants, what should be the amount sought?

Section C(Attempt all of the following)

Q10

Find the critical path and calculate the Total float and Free float for the following PERT diagram.



OR

A small project has 7 activities and the time in days for each activity is given below:

Activity	Duration in days
A	6
B	8
C	3
D	4
E	6
F	10
G	3

Given that activities A and B can start at the beginning of the project. When A is completed C and D can start. E can start only when B and D are finished. F can start when B, C and D are completed and is the final activity. G can start when E is finished and is the final activity.

Activity	Immediate predecessor	Time in days
A	-	6
B	-	8
C	A	3
D	A	4
E	B, D	6
F	B, C or D	10
G	E	3

Draw the network and

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CO4

	find the project completion time.		
Q11	<p>A manufacturer of bags makes three types of bags P, Q and R which are processed on three machines M1, M2 and M3. Bag P requires 2 hours on machine M1 and 3 hours on machine M2 and 2 hours on machine M3. Bag Q requires 3 hours on machine M1, 2 hours on machine M2 and 2 hours on machine M3 and Bag R requires 5 hours on machine M2 and 4 hours on machine M3.</p> <p>There are 8 hours of time per day available on machine M1, 10 hours of time per day available on machine M2 and 15 hours of time per day available on machine M3. The profit gained from bag P is Rs 3.00 per unit, from bag Q is Rs 5.00 per unit and from bag R is Rs 4.00 per unit. What should be the daily production of each type of bag so that the products yield the maximum profit?</p>		CO2