

**JAIPURIA INSTITUTE OF MANAGEMENT, NOIDA**

**PGDM / PGDM (M) / PGDM (SM)**

**THIRD TRIMESTER (Batch 2024-26)**

**END TERM EXAMINATIONS, APRIL 2025**

**MAIN EXAM**

Course Name	<b>Operations Research</b>	Course Code	<b>20521</b>
Max. Time	<b>2 hours</b>	Max. Marks	<b>40 MM</b>

**INSTRUCTIONS:**

- All questions are compulsory.
- Use of calculators (simple/ scientific) is permitted.

**Q.1.** In the vibrant city of Indrapur, located along the banks of the sacred Ganges River, the municipality faces the task of optimizing its water distribution network to meet the growing demands of its residents. The primary goal is to ensure efficient water flow from the city's main reservoir to a crucial purification plant, amidst a network of interconnected pipelines. The water distribution network includes a reservoir acting as the source, a purification plant as the sink, and several intermediate nodes where pipes converge and distribute water to different districts.

Specifically, the pipeline from the reservoir to node A can carry up to 15 units of water, while the lines to node B and node C have capacities of 10 and 8 units, respectively. Further, node A connects to both nodes B and C, with capacities of 5 and 7 units. Node B then directs water to the purification plant with a capacity of 10 units, while node C channels a maximum of 12 units directly to the plant.

In this landscape, Indrapur aims to maximize the flow of water from the reservoir to the purification plant, navigating the constraints imposed by each pipeline's capacity. In this landscape, Indrapur aims to maximize the flow of water from the reservoir to the purification plant, navigating the constraints imposed by each pipeline's capacity. On behalf of the Indrapur authority, formulate the problem as maximal flow problem. **(8 Marks)**

**Q.2.** Bharat Gadgets, a leading Indian consumer electronics company, is evaluating the launch of a new line of eco-friendly smartphones. The company has two options: launch the new smartphones or continue with existing product lines. Should they launch, the outcomes vary: a 40% chance of high market acceptance could yield ₹50 crore in profits, a 30% chance of moderate acceptance could bring in ₹20 crore, and a 30% chance of low acceptance could result in a ₹10 crore loss due to associated costs. Conversely, not launching maintains the status quo with no additional financial impact. Choose the appropriate alternative for the Bharat Gadgets. **(8 Marks)**

**Q.3.** In the bustling fast-food market of Delhi, two leading chains, QuickBites and FastFeast, are locked in a competitive advertising battle to capture a greater market share. Each company has distinct advertising strategies: QuickBites can opt for TV ads, social media ads, or billboards, while FastFeast can choose between TV ads, social media ads, print media ads, and in-store promotions. The following is the payoff matrix that reflects various positive and negative outcomes against FastFeast's choices.

	F1 (TV Ads)	F2 (Social Media Ads)	F3 (Print Media Ads)	F4 (In-Store Promotions)
Q1 (TV Ads)	2	1	3	7
Q2 (Social Media Ads)	-2	1	0	-1
Q3 (Billboards)	3	6	2	2

Evaluate the strategies for both food chains and identify the suitable strategy for both with the value of the game. (8 Marks)

Q.4. In the bustling smartphone market of India, two dominant brands, TechZone and DigiWave, are engaged in a fierce competition for consumer loyalty. Initially, TechZone holds a 60% market share, while DigiWave controls the remaining 40%. Each period, a portion of consumers switch brands: 20% of TechZone's customers move to DigiWave, while 15% of DigiWave's users transition to TechZone. Both the companies aim to understand their respective market shares in the coming period, providing strategic insights into consumer retention and acquisition trends in this rapidly evolving industry. Solve to find the market share for each of the brand after two periods of time. (6 Marks)

Q.5. A company manufactures four variants of the same product and in the final part of the manufacturing process there are assembly, polishing and packing operations. For each variant the time required for these operations is shown below (in minutes) as is the profit per unit sold.

	Assembly	Polish	Pack	Profit (£)
Variant 1	2	3	2	1.50
Variant 2	4	2	3	2.50
Variant 3	3	3	2	3.00
Variant 4	7	4	5	4.50

Given the current state of the labour force the company estimate that, each year, they have 100000 minutes of assembly time, 50000 minutes of polishing time and 60000 minutes of packing time available. To understand how many of each variant should the company make per year and what is the associated profit, the situation was formulated as LPP and solved using Solver. The following sensitivity report was generated.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$B\$2	Variant1	0	-1.5	1.5	1.5	1E+30
\$C\$2	Variant2	16000	0	2.5	2	0.142857143
\$D\$2	Variant3	6000	0	3	0.75	0.5
\$E\$2	Variant4	0	-0.2	4.5	0.2	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$F\$4	Assembly Total	82000	0	100000	1E+30	18000
\$F\$5	Polish Total	50000	0.8	50000	40000	10000
\$F\$6	Pack Total	60000	0.3	60000	15000	26666.66667

Based on the report answer the following questions:

- Determine the initial basic feasible solution for the given situation?
- Find the total profit the company would earn by implementing the above solution?
- If the company started producing variant 1, examine what would happen to the profit of the company?
- If the profit related to variant 3 is increased to 4, how will the optimal solution change?
- Determine what would happen to the current optimal solution if the packing time available is increased to 70000.

(10 Marks)