

SET A

Unique Paper Code	: 61011503
Name of the Paper	: Quantitative Techniques in Management
Name of the Course	: Bachelor of Management Studies (CBCS)
Semester	: V
Duration	: 3 hours
Maximum Marks	: 75

Instructions to Candidates:

- (i) All Questions carry equal marks.*
- (ii) The Question paper contains 6 Questions.*
- (iii) Attempt any 4 Questions in all.*
- (iv) Use of Simple Calculator is allowed.*

Q 1 A firm manufactures three different products namely P, Q and R. Three resources A, B, C are used to manufacture the products. One unit of product P requires 3 units of A, 2 units of resource, and 1 unit of C; while a unit of product Q requires 4 units of A, 1 unit of B, and 3 units of C and each unit of product R requires 2 units each of A, B and C. The contribution margin of the three products P, Q and R is Rs. 36, Rs. 42 and Rs. 32 respectively. The availability of resources A, B and C is 120, 54 and 105 units respectively. Formulate the above problem as an LPP and solve it using the simplex method. Determine whether the solution is unique or not? Find the percentage of capacity utilization of each of the resources and determine their shadow price. Write the dual of the formulated problem.

Q 2 How are steady-state probabilities calculated? Explain why are they said to be independent of the initial condition? You are an Electric Vehicle (EV) enthusiast and based on your profile an automobile company (GNC Motors) has hired you to guide them in maximizing their market share. You know that all automobile companies are striving for new strategies in order to protect their market share, they are in the process to shift to EV and are having different strategies. There are two automobile producers who dominate the market. The strategies and change in market shares (in percentage) of GNC Motors is given below:

	GMC Motors		
GNC Motors	In house EV development	Tie up with a firm already in EV for technology	Merge with a firm already in EV
In house EV development	3	4	8
Tie up with a firm already in EV for technology	-3	12	9
Merge with a firm already in EV	6	-2	8

Find out the best strategy which would be optimum for GNC Motors. Also find the value of the optimal net change in market shares.

Q 3 A software company is willing to diversify in a related business for which it has identified few products and services. The available options for diversification along with their initial and recurring cost are as follows:

Option	Initial cost	Recurring cost for staff and material per month
Start manufacturing microchips	1,20,00,000	24,00,000
Start offering consultancy for software it develops	20,00,000	36,00,000

Start cloud service	2,00,00,000	18,00,000
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Note that the initial cost will be written off over a period of 10 years.

Three states of the economy are possible, namely Boom, Moderate and Recession with a likelihood of 60%, 25%, and 15% respectively. The demand & pricing per unit for the first year will be as follows:

State of economy	Demand (in units)			Price (in Rs)		
	Start manufacturing microchips	Start offering consultancy for software it develops	Start cloud service	Start manufacturing microchips	Start offering consultancy for software it develops	Start cloud service
Boom	150000	160000	90000	100	80	50
Moderate	120000	140000	80000	90	60	40
Recession	70000	80000	50000	60	40	30

Assuming that the company will base its decisions on the pay-off for the initial year of production, determine the decision under uncertainty using the criteria of Maximin, Maximax, Laplace, Hurwicz principle ($\alpha = 0.4$) and Savage principle. Also determine the Expected payoff, EPPI and EVPI.

Q 4 Evaluate the simplex table given below to determine whether the solution is feasible, why or why not? Find the optimal solution and value of the objective function. Is the solution unique or multiple? Give reason for your answer.

	C_j	20	10	0	0	0	M	M	
Basic Variable		X_1	X_2	S_1	S_2	S_3	A_1	A_2	b_i
S_1	0	0	5/3	1	1/3	0	-1/3	0	30
X_1	20	1	1/3	0	-1/3	0	1/3	0	10
A_2	M	0	5/3	0	4/3	-1	-4/3	1	20

Given that the availability of resources is 40, 30 and 60 units respectively, perform the sensitivity analysis with respect to the resource represented by S_1 and objective function coefficient of variable X_2 . Interpret its implication for the obtained solution.

Q 5 Explain how will you modify an assignment problem where, (i) the objective function is to be maximized, (ii) some assignments are prohibited? A Company has factories at F1, F2 and F3 which supply at markets M1, M2 and M3. The following table shows the initial solution to the transportation problem:

Factory	Market			Supply
	M1	M2	M3	
F1	180 16	20 20	12	200
F2	14	100 8	60 18	160
F3	26	24	90 16	90
Demand	180	120	150	450

Is the above solution feasible, give reason for your answer? Is it optimal, if not find the optimal transport schedule? Does this problem have more than one optimal solution? Why or why not? If the transport cost for route F3 – M2 is reduced by Rs 4 will the optimal solution change, explain with reason.

Q 6. A Company is planning the production of an advanced computer chip. It has identified the following jobs, duration and sequence which have to be completed for the success of the production process:

Job	Time		Cost		Preceding Activity
	(in months)		(in Rs)		
	Normal	Crash	Normal	Crash	
A	3	1	45,000	63,000	-
B	2	1	15,000	23,000	-
C	12	10	85,000	1,05,400	A
D	8	6	4,50,000	5,00,000	B
E	4	3	40,000	49,500	C
F	3	1	25,000	41,000	E
G	6	5	50,000	59,000	D, F
H	7	6	2,00,000	2,20,000	D, F
I	2	2	43,000	43,000	H
J	4	2	50,500	75,000	I

Draw the network diagram and obtain the ES, EF, LS, LF and Total slack. Obtain the critical path and find the duration of the project. Given that the indirect costs per month are Rs 10,000, determine the optimal duration of the project and associated cost.