Q.11. Let x_1 be the no of units of type A belt to be Mfged   1 copy

x_2 be the no of units of type B belt to be Mfged

Max:- $4x_1 + 3x_2 = Z$

S.T:- $2x_1 + x_2 \le 1000$ (time)

$x_1 + x_2 \le 800$ (leather)

$x_1 \le 400$ (Buckle type 1)

$x_2 \le 700$ (Buckle type 2)

$x_1, x_2 \ge 0$

(1.5 Marks)

Qualitative Description

A Company manufactures two variety of leather belts. A & B. The unit profit company realises by selling one unit of each belt ~~\#~~ is Rs 4 and Rs. 3 respectively. Each unit of belt A requires a unique buckle, maximum of ~~[illegible]~~ 400 units of the same are available. Each unit of belt B requires a buckle, the maximum supply available for the same is 700 units. The belts ~~are~~ manufactured in a common production process that shares labour and leather. Each unit of belt A requires 2 units of labour & one unit of leather, while each unit of belt B requires one unit of labour & one unit of leather. The maximum supply of labour & leather are 1000 units & 800 units respectively. Formulate the problem to maximize profits.

(1.5 marks)

Q12

(a) RHS Sensitivity analysis of Machine hours

Slack variable representing Machine hours = S_3

original resource value = 52

Q^*	S_3^*	+ve ratio	-ve ratio
11	$-1/4$	-	-44
8	-2	-	-4
2	$1/2$	4	-

LB = 52 − 4 = 48

UB = 52 + 4 = 56

Permissible decrease = 4 hrs

The maintenance people can take 4 hours to repair the M/c.

(0.5 Marks)

(b) slack variable that representing Labour S_2

original resource value = 40

Q^*	S_2^*	+ve ratio	-ve ratio
11	0	∞	
8	1	8	
2	0	∞	

$$LB = 40 - 8 = 32$$

permissible decrease = 8 hrs

one day off can be given to workers

(1.5 marks)

Q13

Profit/unit	Basis	Q	x_1	x_2	s_1	s_2	s_3	s_4	CR
		c_j	4	3	0	0	0	0	
3	x_2	200	0	1	1	0	-2	0	-100
0	s_2	200	0	0	-1	1	1	0	200
4	x_1	400	1	0	0	0	1	0	400
0	s_4	500	0	0	-1	0	2	1	250
	$[z_j]$	[2200]	4	3	3	0	-2	4	
	$c_j - z_j$		0	0	-3	0	+2	-4	

← outgoing variable

↑ Incoming variable

(01 Mark)

Profit/unit	Basis	Q	x_1	x_2	s_1	s_2	s_3	s_4
		c_j	4	3	0	0	0	0
3	x_2	600	0	1	-1	2	0	0
0	s_3	200	0	0	-1	1	1	0
4	x_1	200	1	0	1	-1	0	0
0	s_4	100	0	0	1	-2	0	1
	$[z_j]$	[2600]	4	3	1	2	0	0
	$c_j - z_j$		0	0	-1	-2	0	0

∵ All $c_j - z_j$ values are either 0 or -ve, the solution is optimal

(02 Marks)

Q.15 Slack variable representing Raw material ⇒ S_1

Q^*	S_1^*	+ve ratio	-ve ratio
175	1	175	–
300	0	–	–
375	0	–	–

original value = 2500

Lower bound = 2500 − 175 = 2325

Upper bound = ∞

(1.5 marks)

No of units to be scrapped = 500

Alternate available from regular vendor = 200

Net shortage of RM = 500 − 200
= 300

Permissible decrease = 175

* Additional units needed to maintain
* the pre determined production plan = 125 units

(1.5 marks)

Q.14 Let x_1 be the no of units of product A to be Mfged
x_2 be the no of units of product B to be mfged
x_3 be the no of units of product C to be mfged

Max: $Z = 90x_1 + 40x_2 + 30x_3$

S.T: $6x_1 + 5x_2 + 2x_3 \leq 5000$ (RM P)

$4x_1 + 7x_2 + 3x_3 \leq 6000$ (RM Q)

$x_1 + \frac{x_2}{2} + \frac{x_3}{3} \leq 1600$ (Mfg time)

$x_1 : x_2 : x_3 = 3:4:5$; $\frac{x_1}{3} = \frac{x_2}{4}$; $\frac{x_2}{4} = \frac{x_3}{5}$ ⇒ $4x_1 - 3x_2 = 0$
$5x_2 - 4x_3 = 0$

$x_1 \geq 300$; $x_2 \geq 250$; $x_3 \geq 200$

$x_1, x_2, x_3 \geq 0$ (3 marks)

8|6

	1	2	3	4	5	Dummy	Dem
A	[2] 75	[3] 75	[4]	[4]	[M]	[0] 700	850
B	[4]	[M] 30	[3] 180	[6] 90	[6]	[0]	300
C	[6]	[7] 240	[8]	[M]	[5] 210	[0]	450
Supply	75	345	180	90	210	700	

$m+n-1 = 8$ solution is non degenerate

$Z = 7185$/- (Assume $M = 100$)

(Formulation & generation of basic feasible solution 3 marks)

8|7 Optimizing the above solution

II transportation table

$Z = 4275$

$m+n-1 = 8$ Sol^n is non-degenerate. (01 mark)

III - transportation table

$Z = 3315$

$m+n-1 = 8$, Sol^n is non-degenerate (01 mark)

Final transportation table

	1	2	3	4	5	Dummy	Dem
A	[2] 75	[3] 345	[4] (+)	[4] 90	[M] (+)	[0] 340 ~~700~~	850
B	[4] (+)	[M] (+)	[3] 180	[6] (+)	[6] (+)	[0] 120	300
C	[6] (+)	[7] (+)	[8] (+)	[M] (+)	[5] 210	[0] 240	450
Supply	75	345	180	90	210	700	

$Z = 3135$

Solution is optimal (02 marks)

18

	P	Q	R	S	T
A	85	75	65	125	75
B	90	78	66	132	78
C	75	66	57	114	69
D	80	72	60	120	72
E	76	64	56	112	68

⇒ total opp lost Matrix

2	2	$\cancel{0}$	4	$\boxed{0}$
6	4	$\boxed{0}$	10	2
$\boxed{0}$	1	$\cancel{0}$	1	2
2	4	$\cancel{0}$	4	2
2	$\boxed{0}$	$\cancel{0}$	$\cancel{0}$	2

(0.5 marks)

(1.5 Marks)

2	2	2	4	$\boxed{0}$
4	2	$\boxed{0}$	8	$\cancel{0}$
$\boxed{0}$	1	2	1	2
$\cancel{0}$	2	$\cancel{0}$	2	$\cancel{0}$
2	$\boxed{0}$	2	$\cancel{0}$	2

No line

2	1	2	3	$\boxed{0}$
4	1	$\boxed{0}$	7	$\cancel{0}$
$\cancel{0}$	$\cancel{0}$	2	$\boxed{0}$	2
$\boxed{0}$	1	$\cancel{0}$	2	$\cancel{0}$
3	$\boxed{0}$	3	$\cancel{0}$	3

(01 Mark)

A → T - 75
B → R - 66
C → S - 114
D → P - 80
E - Q - 64
399

(0.5 Marks)