Roll No. ....

Total No. of Questions – 7

Total No. of Printed Pages – 16

Time Allowed – 3 Hours

Maximum Marks – 100

BAT

Answers to questions are to be given only in English except in the case of candidates who have opted for Hindi Medium. If a candidate has not opted for Hindi medium, his/her answers in Hindi will not be valued.

Question **No. 1** is compulsory.

Answer any **five** questions from the remaining six questions.

In case any candidate answers extra question(s)/sub-question(s) over and above the required number, then only the requisite number of questions first answered in the answer book shall be valued and subsequent extra questions answered shall be ignored.

Working notes should form part of the answer.

No statistical or other table will be provided with this question paper.

Wherever necessary, candidates may make appropriate assumptions and clearly state them.

Marks

1. (a) A company manufactures three components, A, B and C. These components pass through machines P and Q. The machine hour capacity of Q is limited to 7800 hours a month. The company is interested in fulfilling the market demand to retain its market share. The following information is given :   **5**

		A	B	C
Demand (units/month)		1200	1200	1500
Variable cost (₹ / unit)		187	215	111
Fixed cost (₹ / unit)		115	115	55
(at normal capacity utilization)				
Hours per unit	P	2	2	$1\frac{1}{2}$
	Q	3	3	1

Component B has to be made by the company. There is a supplier available for components A and C at ₹ 280 and ₹ 161 per unit respectively.

(i)   Which component(s) and in what quantities should be purchased to minimize costs ?

(ii) From a financial perspective, what do you need to ensure in order to justify your answer in (i) above ?

(b) The following independent situations relate to new product pricing.   **5**
     Classify the products into the appropriate category : Revolutionary
     Product (RP), or Evolutionary Product (EP) or a Me-Too Product (MP)
     and state the corresponding pricing to be followed :

Sl No.	Situation	RP/EP/MP	Pricing
I	II	III	IV
(i)	Adjustable work table like a stool, has been successfully capturing the market. Company X makes a small variant of this product and is trying to enter the market.		
(ii)	R & D has just been completed on an innovative computer processor in the shape of a pen, with accompanying pen-like devices to act as keyboard projector and monitor projector. This is expected to get the laptops out of business due to extreme ease of portability of just 3 pen-like light weight devices.		

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(iii)   A successful mobile manufacturing company has built into its latest mobile phone, an additional sliding screen and improved its processor capabilities so that the phone is almost a laptop.

You may present only columns I, III & IV. You are required to explain the pricing in one sentence.

(c) XY Ltd. manufactures two types of mobile phones, X and Y. Due to severe competition, it has to reduce the prices for the next production period. The following information is provided :   **5**

	X	Y
<u>Current period</u>		
Selling price (₹ / unit)	10,000	12,000
P/V ratio	25%	30%
Product-specific fixed cost (₹)	10,00,000	15,00,000
<u>Next Period</u>		
Selling price (₹ / unit)	8,000	9,000

For the next period the company wants the present P/V ratio to be maintained and achieve a break-even for both the products at 400 units. What is the cost reduction programme envisaged ?

BAT   **Marks**

(d)   The following 3 × 3 matrix arises after the Row minimum and Column   **5**
minimum operation of a minimization assignment problem :

Columns / Rows	C_1	C_2	C_3
R_1	0	0	0
R_2	0	a	b
R_3	0	c	d

Given that a ≠ b ≠ c ≠ d ≠ 0, (i.e. a, b, c, d are non zero and unequal),
will $R_1 C_1$ (cell at the intersection of Row 1 and Column 1) appear in
the final solution under the assignment algorithm ? Why ? Interpret this
part of the algorithm.

2.   (a)   ABC Ltd. produces a gadget made up of special steel plates. The   **6**
company gets an order for supply of 50,000 gadgets at a price of ₹ 680
per unit.

The gadgets are made of two halves (upper part and lower part) and
then welded together.

The cost structure is :

Materials 15 kg. per half @ ₹ 10 per kg ; Labour ₹ 60 per half.

Welding charges and fitting charges would be ₹ 20 per gadget.

The special steel plates are in short supply and ABC Ltd. has stock of
only 750 Tons. A supplier has only the lower part and has offered to
supply 50,000 numbers. Transportation and handling will cost ₹ 6 per
half. (consider 1 ton = 1000 kg)

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ABC Ltd. could either execute its order to the extent of material available, or could fulfill the entire order by buying the lower part from the supplier. Evaluate both the options and find out the maximum price that ABC would be willing to pay the supplier per lower part if.

(i)   it wants to retain the same level of profit per unit as in own manufacture.

(ii)   if any additional revenue is preferred.

Present your calculations to the nearest rupee.

(b)   The following information on activities, the Earliest Start Time (EST),   **10**
Latest Start Time (LST), Earliest Finish Time (EFT) in days is given for a certain project :

Activity	EST	LST	EFT	Crashing Cost ₹ / day
A	0	0	5	1000
B	0	6	6	2000
C	5	8	9	3000
D	5	7	8	4000
E	5	5	6	5000
F	6	6	10	6000
G	10	10	24	7000
H	9	12	21	8000
I	24	24	26	9000

Given that : G is immediately preceded by F and D.

B's successor is H and H's successor is I. It is not possible to have a zero duration activity.

BAT

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(i)   What is the project completion time ?

(ii) Find the LFT (Latest Finish Times) of activities C, D, H and B.

(iii) Reduce the project duration by three days, by performing step by step crashing to minimize crashing cost assuming that no activity can be crashed by more than one day.

(iv) After the crashing exercise, if activity H's duration is increased by one day, by how many days can you increase the duration of each of the activities B and C without delaying the project beyond its crashed duration ? Explain the underlying concept.

(You are not expected to present the network diagram).

(You may opt the following format for your answer).

Sl. No.				
(i)	Duration	=	_____	
(ii)	LFT :			
		C :	_____	
		D :	_____	
		H :	_____	
		B :	_____	
(iii)	Step	Crash Activity	Days	Cost (₹)
	I			
	II			
	III			
(iv)	Activity	Increase duration by (days)		
	B	_____		
	C	_____		
Concept				

BAT

3. (a) PAL Limited is considering manufacture and launch of 1000 units of a   6
         special product 'L X 4' into the market.

         The Direct Labour Rate budgeted is ₹ 96 per hour.

         Direct labour costs are expected to reduce as the volume of output
         increases due to the effects of 80% learning curve (index is – 0.3219).
         The expected time to be taken for the first unit is 40 hours and the
         learning effect is expected to end after 250 units have been produced.
         The units produced after the first 250 units will take the same time as
         the 250th unit.

         (i)   Calculate the standard labour hours expected over the 1000 units.

         (ii) If the actual hours were 6000, compute the labour efficiency
               variance over the 1000 units.

         (iii) Without the learning curve application, how would you have
               reported the efficiency variance, taking the standard time per unit
               as the expected time for the first unit ?

         [**Note :** $250^{-0.3219} = 0.1691$; $249^{-0.3219} = 0.1693$]

    (b) The following matrix is a transportation cost matrix giving unit costs   10
         from Factories F_1, F_2 and F_3 to Destinations D_1, D_2 and D_3 :

Factory / Destination	F_1	F_2	F_3	Demand	
D_1	⌊3	⌊6	⌊7	60	$u_1 = 0$
D_2	⌊8	⌊5	⌊7	30	
D_3	⌊4	⌊9	⌊11	30	
Supply	35	55	30		

         (i)   Find the initial solution by the Least Cost Method.

         (ii) Is the solution non-degenerate ? Can you expect a degenerate
               solution in such a situation ? Why ?

         (iii) Compute the Δij matrix by taking $u_1 = 0$ as shown.

(iv) If you considered $u_1 = 5$ and did the $u_i + v_j$ matrix, would the Δ_{ij} matrix be different from the one you have computed in (iii) above ? Why ? (You are not expected to show the revised computation.)

(v) Find the initial solution by the North West Corner Rule.

4. (a) A Tea company manufactures two brands of tea namely Super and Normal by blending of four grades of tea leaves as raw material in the following proportion : 8

Raw Material	Product Super	Product Normal
Grade A	70%	
Grade B	30%	
Grade C		40%
Grade D		60%

During the month of May 2017, it is expected that 200 tons of brand Super and 80 tons of brand Normal will be sold. Actual and budgeted inventories for the month of May 2017 are as follows :

	Actual inventories on 1st May, quantity in Tons	Budgeted inventories on 31st May, quantity in Tons
Grade A	40	50
Grade B	25	56
Grade C	150	250.90
Grade D	60	40.50
Product Super	40	20
Product Normal	20	15

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Purchased tea leaves are seasoned and then held in stock or issued for production. During seasoning, they lose 15% of their initial weight. Calculate the following :

(i)   The Production Budget for the month of May 2017 (in quantity)

(ii) The Raw Material Purchase Budget for May 2017 (in quantity)

(b) The following data pertains to a company which uses standard marginal costing for manufacture and sale of a single product during the year.   8

Particulars	Budget	Actual
Sales (in units)	60,000	66,000
Sales (₹)	1,80,00,000	2,14,50,000
Direct Materials (₹)	28,80,000	36,30,000
Direct Labour (₹)	43,20,000	52,80,000
Variable Overheads (₹)	72,00,000	81,84,000
Total Variable Costs	1,44,00,000	1,70,94,000

Additional information is as follows :

	Standard	Actual
Direct material price per kg	₹ 12	₹ 11
Direct labour rate per hour	₹ 9	₹ 10

Calculate the following variance for the year and indicate the type of variance favourable (F), unfavourable (U) or adverse (A).

(i)   Direct material usage variance

(ii) Direct material price variance

(iii) Direct labour efficiency variance

(iv) Direct labour rate variance

(v)   Variable overhead cost variance

(vi) Sales margin volume variance

BAT **Marks**

5. (a) A company can make any or both of products A and B in a production period not exceeding a total of 10,000 units due to non-availability of the required material and labour. Until now, the company had been taking decisions on the product mix, based on the following marginal cost analysis. **12**

	A (₹ / u)	B (₹ / u)
Selling Price	100	120
Variable Cost	60	70
Contribution	40	50
Total fixed costs		3,00,000

Since the decisions based on the above approach did not yield the required results, the fixed costs were analysed as follows for 10,000 units of only A or 10,000 units of only B.

Item of Cost	Details for A	A (Amt)	B (Amt)	Details for B
Set up cost	10 production runs	40,000	75,000	10 production runs
Distribution cost	₹ 120 / box	60,000	25,000	₹ 200 per box
Step fixed cost	₹ 4,000 per 2,000 units	20,000	50,000	₹ 5,000 per 1000 units
Total		**1,20,000**	**1,50,000**	

₹ 30,000 can be taken as the unanalysed fixed cost, and unavoidable whether A or B or both are produced.

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The following cost reduction measures were taken by the Product Managers of A and B :

	A	B
Increase in number of units per run to	2000 units	1250 units
Increase in the number of units per box distributed to	30 units	125 units

Further, the Management ensured availability of raw material and labour to support a production of 15000 units of either A or B or both together. There was no change to the step costs or contribution. However, the total unanalysed fixed cost increased to ₹ 32,000.

(i) Based on the principles of Activity Based Costing, prepare a statement showing the contribution and item wise analysed overheads for each product, arrive at the profitability of A and B and then the final profits if 15000 units of only A or 15000 units of only B are manufactured.

(ii) Find the minimum break-even point in units if only product A is manufactured after the cost reduction.

(b) A toy company 'T' expects to successfully launch Toy Z based on a film character. T must pay 15% royalty on the selling price to the film company. T's targets a selling price of ₹ 100 per toy and profit of 25% selling price.   **4**

The following are the cost data forecast :

	₹ / toy
Component A	8.50
Component B	7.00
Labour : 0.4 hr @ ₹ 60 per hr	24.00
Product specific overheads	13.50

In addition, each toy requires 0.6 kg of other materials, which are supplied at a cost of ₹ 16 per kg with a normal 4% substandard quality which is not usable in the manufacture.

You are required to determine if the above cost structure is within the target cost. If not, what should be the extent of cost reduction ?

6. (a) Supreme Limited has two Divisional Profit Centres A and B. A   **8**
         produces two components 'AC' and 'PC' and has a maximum capacity
         of 1,20,000 hours per annum, which can be used for AC or PC.
         The following information is given :

Details	Division A		Division B
	AC	PC	RAC
Direct Material ₹/unit	25	10	100
Imported Component (equivalent of AC) ₹ / unit	–	–	450
Direct Labour and Variable Overhead ₹ / unit	–	–	–
@ ₹ 50 / hour	200	50	
@ ₹ 35 / hour			350
Fixed cost ₹ / annum	30,00,000		6,00,000
External demand (no of units)	18,000	Unlimited	6,000
External selling price (₹ / unit)	450	90	1050

Division B presently imports a component which is similar to AC at ₹ 450. If it uses AC from Division A, it has to make some modification which will involve two direct labour hours, thereby increasing the cost by ₹ 70/- per modified unit.

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What is the minimum transfer price per unit that A will agree to, if the requirement of B is

(i)   12,000 units

(ii)   15,000 units ?

(iii)   What is the maximum price that B will offer A per unit of AC transferred if its labour hours are restricted to 6,00,000 hours ?

Is it in the company's interest that A transfers units to B after meeting its external demand for AC

(iv)   If B's labour hours are restricted to 6,00,000 hours ?

(v)   If B's labour hours have no limitation ?

(Present your answers from a financial perspective and with only relevant figures. A detailed profitability statement is not required)

(b)   PH Ltd. makes and supplies pizzas to three colleges A, B and C across the city. It is exploring the viability of discontinuing C and supplying to a nearer college 'D'. However, there is an extra quantity of 800 units which it can supply to A if it discontinues C. The details are given below :   **8**

		A	B	C	D
No. of Pizzas	(existing)	1500	2500	4800	–
	Proposed	*			4000
Contribution ₹ / unit excluding delivery costs		72	67	65	60
(km / delivery) Distance		20	30	40	25
No. of deliveries (normal)		100	125	400	200
No. of rush deliveries (₹ 200 / rush delivery)		–	40	20	30
Normal Delivery Cost (₹ / km) (not applicable to rush deliveries)		20	20	20	20

*If it has to supply 800 extra units to A, if has to reduce the price on the original supply also. Moreover, these 800 units will involve 65 normal deliveries and 20 rush deliveries.

(i) Prepare a customerwise profitability statement based on the existing quantities given in the table for A, B and C and the proposed 4000 numbers for D.

(ii) By how much can PH reduce the price per unit supplied to college A in order to justify the additional supply ?

7. Answer any **four** out of the following **five** questions :

(a) The following is the data for a minimisation problem of a linear   4 program in the simplex method.

Minimize $Z = 3x_1 + 4x_2$, subject to

$$2x_1 + 3x_2 \geq 150$$

$$4x_1 + 3x_2 \geq 120$$

$$x_1, x_2 \geq 0$$

Assume usual notations for additional variables s_1, s_2 for conversion to equality.

(i) What would be the coefficient of the artificial variables in the objective function ? Why ?

(ii) Will s_1 and s_2 be part of the initial solution ? Why ?

BAT   **Marks**

(b) The following information is given about the type of defects during a production period and the frequencies of their occurrence in a spectacle manufacturing company :   **4**

Defect	No. of items
End Frame not equidistant from the centre	10
Non-uniform grinding of lenses	60
Power mismatches	20
Scratches on the surface	110
Spots / Stains on lenses	5
Rough edges of lenses	70
Frame colours-shade differences	25

Construct a frequency table so that a Pareto Chart can be constructed for the defect type. Which areas should the company focus on ?

(c) Classify the following items under the three measures used in the theory of constraints : viz Throughput Contribution, Operating Costs and Investments.   **4**

(i) Research and Development Cost

(ii) Rent/Utilities

(iii) Raw materials used for production

(iv) Depreciation

(v) Labour Cost

(vi) Stock of raw materials

(vii) Sales

(viii) Cost of equipments and buildings

(d)   (i)   Is it necessary to start preparing a functional budget only after identifying the principal budget factor ? Explain.   **4**

(ii)   Is it practical to make a flexible production cost budget before the commencement of production activities of a certain production period ? Why ?

(e)   Classify the following costs into one or more the following categories :   **4**
Relevant cost, Opportunity cost, Sunk cost, Notional cost and Historical cost.

A company wishes to manufacture 'Smart' watches that can be interactive with mobile phones, computers and CCTV systems. It is planning to do research on the compatibility. It has done market survey and is satisfied about the demand being sufficient for making the product profitable. Some facilities can be made available by discontinuing its existing line of telephone instruments division.

(i)   R & D costs indicated above

(ii)   Cost of Market Survey

(iii)   The profit of the Telephone Instruments Division

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BAT