



- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Due credit will be given to neatness and adequate dimensions.
  9. Assume suitable data whenever necessary.
  10. Use of non programmable calculator is permitted.
  11. Normal distribution chart (X & R charts is permitted)

1. a) Define productivity. State the objectives and types of productivity. 6
- b) The data for output produced and input used by a company for a specified period is given in the table. Assuming deflector for output and all inputs as 1.2 find the partial and total productivity indices? 7

Particular	Output	Input	Labour	Material	Energy	Other
Year 2012	Rs. 1,00,000	-	Rs. 30,000	Rs. 20,000	Rs. 7,000	Rs. 5000
Year 2013	Rs. 1,20,000	-	Rs. 35,000	Rs. 22,000	Rs. 10,000	Rs. 6000

**OR**

2. a) Define motion study and explain different tools and methods for conducting micro motion study. 6
- b) Explain the importance and application of various charts used in recording techniques during method study. 7
3. a) Define predetermined motion time system and explain types of PMT's. 6
- b) A work sampling study was conducted to establish the standard time for an operation. The observations of the study conducted is given below. 7  
 Total No. of observations = 160  
 Manual (Hand controlled work) = 14  
 Machine controlled work = 106  
 Average performance rating = 80%  
 No of parts produced = 36  
 Allowances for personal need and = 10% fatigue  
 study conducted for 3 days. Available working hours/day = 8 hrs.  
 Calculate the standard time per piece.

**OR**

4. a) "Ergonomics enhances quality of work life" comment. 6
- b) The elemental times (in min) for 4 cycles of an operation using a stop watch are presented below. 7

Elements	Cycle time in minutes			
	1	2	3	4
1	1.5	1.5	1.3	1.4
2	2.6	2.7	2.4	2.6
3	3.3	3.2	3.4	3.4
4	1.2	1.2	1.1	1.2
5	0.51	0.51	0.52	0.49

Calculate standard time for the operation if

- i) Elements 2 & 4 are machine elements.
- ii) For other elements, the operates is rated at 110%
- iii) Total allowances are 15% of the normal time.
5. a) Discuss the objectives of sales forecasting. What are the various methods of sales forecasting? Discuss their merits and limitations. 7
- b) A company manufacturing washing machine establishes a fact that there is a relationship between sales of washing machines and population of the city. The market research carried out reveals the following information 7

Populations (millions)	5	7	15	22	27	36
No. of Washing Machines demand ('000)	28	40	65	80	96	130

Fit a linear regression equation and estimate the demand for washing machines for a city with population of 45 million.

**OR**

6. a) The past sales of three months is given below for the year 1996 7  
 Oct. Nov. December  
 300 350 400  
 The forecasted demand for October was 315 units, forecast the sales for Jan. 1997 assuming  $\alpha = 0.4$ .
- b) The sales of domestic water pump manufactured by Ajit manufacturing company is given 7  
 forecast the demand for the pumps for the next three years using least square method.

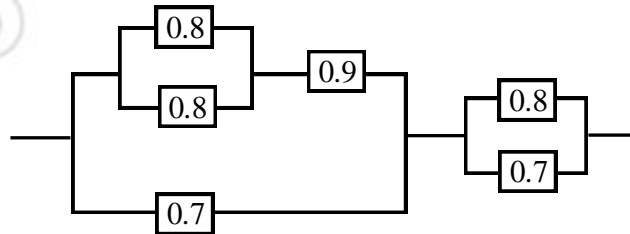
Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Sales (000)	30	33	37	39	42	46	48	50	55	58

7. a) Explain Bath tub curve with its applications in manufacturing. 6

- b) Find the reliability of a 3 unit parallel system with the reliability of individual units as 0.6, 0.7, 0.8 7  
 For the above parallel system. Should we add one more unit with the reliability 0.6 or improve the reliability of each unit by 10% to improve the reliability of the system to a great extent.

**OR**

8. a) Define reliability. How can this be improved at design stage? 6  
 b) Calculate the reliability of system shown in fig. below. Reliability of each element is also given in fig. 7



9. a) Determine control limits for X and R charts if  $\bar{X} = 357.5$ ,  $R = 9.90$ , Number of sub-groups = 20. It is given that  $A_2 = 0.18$ ,  $D_3 = 0.41$ ,  $D_4 = 1.59$  and  $d_2 = 3.735$ . Also find the process capability. 7  
 b) In a manufacturing process, the number of defectives found in the inspection of 10 lots if 400 items each are given 7

Lot No.	1	2	3	4	5	6	7	8	9	10
Defectives	2	0	14	3	1	18	6	0	3	6

Determine the control limits for appropriate control chart and state whether the process is in control

**OR**

10. a) A machine is working to a specification of  $12.58 \pm 0.05$  mm. A study of 50 consecutive pieces shows the following measurement put into 10 group of 5 each. 7

1	2	3	4	5	6	7	8	9	10
12.62	12.63	12.62	12.61	12.59	12.57	12.57	12.58	12.61	12.56
12.60	12.56	12.56	12.66	12.58	12.63	12.56	12.57	12.60	12.59
12.62	12.60	12.57	12.62	12.57	12.60	12.61	12.60	12.62	12.62
12.61	12.59	12.58	12.61	12.59	12.60	12.50	12.60	12.60	12.58
12.65	12.60	12.63	12.60	12.56	12.59	12.59	12.61	12.65	12.54

- Determine the process capability
- Determine the 3 sigma limits for X chart
- Does it appears that the machine is capable of meeting the specification requirement?
- Calculate the present defective if any
- Suggest possible ways by which the percent defective can be reduced?

- b) Define quality control. What is the need of process control chart? 7
11. a) Explain ISO 9000 series in details. 6
- b) Discuss significance of average outgoing quality curve. What is AOQL? How this limit helps in minimizing the acceptance of bad quality items. 7

**OR**

12. a) Write short notes on : 6
- a) Quality assurance & quality planning.
- b) Six sigma & Quality audit.
- b) A single sampling plan uses a sample size of 16 and the acceptance number 1. Using hyper geometric probabilities, compute probability of acceptance of a lots of 50 articles with 2% defectives. 7

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