Time allowed: 2 Hours 30 mins   **Max Marks:50**

Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means.** In case of rough work please use answer sheet.

Sections	No. of Questions to attempt	Marks	Marks
A	3 out of 5 (Short Questions)	5 Marks each	3*5 = 15
B	2 out of 3 (Long Questions)	10 Marks each	3*10 = 20
C	Compulsory Case Study	15 Marks	15
		Total Marks	**50**

SECTION A

Q1. Are specification and control limits the same? Explain?

Q2. What is a relationship between the service level and safety stock? Consider an item that is ordered once per month. The daily requirement is 200 and the lead time for supply is two days. There are 25 working days in a month. The cost of ordering is INR 300 per order and carrying cost is INR 150 per unit per year.
a. draw a sketch showing the cyclic and pipeline inventory in the system.
b. What is the cost of this plan?

Q3. The first batch of a new product has just been made. The batch size was 20 units and the total time taken was 200 hours – i.e. an average of 10 hours per unit. A 90 per cent learning curve is expected to apply. You are required to estimate the following:
a. The cumulative average time for the first two batches.
b. The total time to produce 40 units.
c. The incremental time for 41 to 60 units – i.e. a third batch of 20 units.
Note:- b is (-.152)

Q4. Ind. Swift Industries is compiling the monthly productivity report for its Board of Directors. From the following data, calculate (a.) Labor productivity(b.) Machine productivity (c.) The multifactor productivity of dollars spent on labor, machine, material and energy. The average labor rate is $15 an hour, and the average machine usage rate is $10 an hour.

Unit produced   100,000
Labor hours   10,000
Machine hours   5,000
Cost of Material $ 35,000
Cost of energy $ 15,000

Q5. A. Rohit is trying to decide which internet service provider to use. His friend are always complaining about service interruptions and how long it takes to get the service up and running again. Rohit is conscientious student and wants reliable access to the internet.

With that objective in mind he collected data on mean time between failures (MTBF) and mean tie to repair (MTTR) for three internet service providers. Considering that cost and speed are comparable among the three options, which providers would you recommend. (2 marks)

Provider	MTBF	MTTR
Airtel	20	1
Aircel	40	4
BSNL	80	6

B. How are reliability and maintainability related? Give an example for a product or service you have experienced? (3 marks)

SECTION B

Q1.
   A. Describe the difference between activity on node and activity on arrow project networks? (7 marks)
   B. The Rural Bank of India is planning to install a new computerized accounts system. Bank management has determined the activities required to complete the project, the precedence relationships of the activities, and activity time estimates as follows.

Activity	Description	Activity predecessor	Time estimates(weeks) a	m	b
A	Position recruiting	--	5	8	17
B	System development	--	3	12	15
C	System training	A	4	7	10
D	Equipment training	A	5	8	23
E	Manual system test	B,C	1	1	1
F	Preliminary system changeover	B,C	1	4	13
G	Computer personal interface	D,E	3	6	9
H	Equipment modification	D,E	1	2.5	7
I	Equipment testing	H	1	1	1
J	System debugging	F,G	2	2	2
K	Equipment changeover	G,I	5	8	11

Determine the earliest and latest activity times, the expected completion time and standard deviation and the probability that the project will be completed in 40 weeks or less.(8 marks)

Q2.

A. Philips long life 15-Watt LED are designed to have life of 1125 hours with tolernace of ± 210 hours. The process that makes LED has a mean life of 1050 hours, with standard deviation of 55 hours. Compute the process capability index and comment on overall capability of the process?

B. M/s Shivan & Narresh is an upcoming apparel brand and run their works for 6 days a week for 49 weeks a year. Printed/bleached/dyed cloth is delivered to them directly with a charge of Rs. 7.50 for each delivery. S & N uses average of 10 meters of cloth a day for which they pay Rs. 12 a meter. They have an overdraft with bank which cost 12 percent a year, with spillage shortage, loss and insurance costing 6.75 percent a year.
   a. What size of delivery should S & N use and what is the resulting cost?
   b. How much S & N should order if cloth can be put on shelve for not more than 2 weeks in any how situation?
   c. How much S & N should order if the bank imposes a maximum order value of Rs. 1500.
   d. If the mill only delivers on Monday, how much S & N order and how often.

C. A basic block company needs to produce 4000 boxes of blocks per 40 hours week to meet upcoming holiday demand. The process of making blocks can be broken into six work elements. The precedence and time requirements for each element are as follows. Draw and label a precedence diagram for the production process. Set up a balanced assembly line and calculate the efficiency of the line.

Work elements	Precedence	Performance time (Min)
A	-	.10
B	A	.40
C	A	.50
D	-	.20
E	C, D	.60
F	B,E	.40

Q3. **A.**
a. Does layout make any difference in manufacturing process? Describe a product layout? How does it differ from a process layout?
b. What is the difference between block diagramming and relationship diagramming? When might each be used?

B. What is the purpose of QFD? Touch upon briefly the process of QFD? Discuss the concept of robust designing and briefly emphasize the importance of it with that of QFD?

SECTION C

Dave's Burgers is a fast-food restaurant franchise in Georgia, South Carolina, and North Carolina. Recently, Dave's Burgers has followed the lead of larger franchise restaurants like Burger King, McDonalds and Wendy's and constructed drive-through windows at all its locations. However, instead of making Dave's Burgers more competitive, the drive-through

windows have been a source of continual problems, and it lost market share to its larger competitors in almost all locations. To identify and correct the problems, top management has selected three of its restaurant (One in each state) as test sites and had implemented a quality management program at each of them. A quality team made up employees, managers, and quality specialist from company headquarters, at the Chartolle, North Carolina, test restaurant using traditional quality tools like Pareto charts, check sheets, fishbone diagrams and process flowcharts have determined that the primary problems is slow, erratic service at drive through window. Studies show that from the time of a customer arrives at the window to the time of the order is received averages 2.6 minutes. To be competitive management believes service time should be reduced to at least 2.0 minutes and ideally 1.5 minutes.

The Charlotte Dave's Burgers franchise implemented a number of productions process changes to improve service time at the drive through window. It provided all employees with more training across all restaurant function, improves the headset system, improves the equipment layout, developed clearer sings for customers, streamlined the menu, and initiated even-dollar (tax-inclusive) pricing to speed the payment process. Most importantly the restaurant installed large, visible electronic timers that showed how long a customer was at the window. This not only allowed the quality team to measure service speed but also provided employees with a constant reminder that a customer was waiting.

These quality improvements were implemented over several months, and their effect was immediate. Service speed was obliviously improved, and market share at the Charlotte restaurants increased by 5%. To maintain quality service time remained fast, and continue to improve service, the quality team decided to use a statistical process control chart on a continuing basis. They collected six service time observations daily over a 15-day period, as follows.

Observation of Service Time (Min)

Sample	1	2	3	4	5	6
1	1.62	1.54	1.38	1.75	2.5	1.32
2	1.25	1.96	1.55	1.66	1.38	2.01
3	1.85	1.01	0.95	1.79	1.66	1.94
4	3.1	1.18	1.25	1.45	1.09	2.11
5	1.95	0.76	1.34	2.12	1.45	1.03
6	0.88	2.5	1.07	1.5	1.33	1.62
7	1.55	1.41	1.95	1.14	1.86	1.02
8	2.78	1.56	1.87	2.03	79	1.14
9	1.31	1.05	94	1.53	1.71	1.15
10	1.67	1.85	2.03	1.12	1.5	1.36
11	0.95	1.73	1.12	1.67	2.05	1.42
12	3.21	4.16	1.67	1.75	2.87	3.76
13	1.65	1.78	2.63	1.05	1.21	2.09
14	2.36	3.55	1.92	1.45	3.64	2.3
15	1.07	0.96	1.13	2.05	0.91	1.66

Construct a control chart to monitor the service at the drive-through window. Determine if your control chart can be implemented on a continuing basis or if additional observations need to be collected. Explain why the chart you developed can or cannot be used. Also discuss what other statistical process control charts Dave's Burgers might use in its overall quality- management program.

Sample Size n	Factor for $\bar{x}$-Chart A_2	Factors for R-Chart D_3	D_4
2	1.88	0	3.27
3	1.02	0	2.57
4	0.73	0	2.28
5	0.58	0	2.11
6	0.48	0	2.00
7	0.42	0.08	1.92
8	0.37	0.14	1.86
9	0.34	0.18	1.82
10	0.31	0.22	1.78
11	0.29	0.26	1.74
12	0.27	0.28	1.72
13	0.25	0.31	1.69
14	0.24	0.33	1.67
15	0.22	0.35	1.65
16	0.21	0.36	1.64
17	0.20	0.38	1.62
18	0.19	0.39	1.61
19	0.19	0.40	1.60
20	0.18	0.41	1.59
21	0.17	0.43	1.58
22	0.17	0.43	1.57
23	0.16	0.44	1.56
24	0.16	0.45	1.55
25	0.15	0.46	1.54