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Program: B. Sc. in IPE  
Semester: Summer

Date: 16 February, 2023  
Time: 10:00 a.m.– 11:30 a.m.

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Mid Semester Examination  
Course Number: IPE 4605  
Course Title: Quality Control and Management

Summer Semester: 2021 - 2022  
Full Marks: 75  
Time: 1.5 Hours

There are 3 (Three) questions. Answer **all** of them.

The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in brackets. Assume reasonable value for any missing data.

1. a. Recently 'Realme', a cellular phone manufacturer, experienced a major increase in its external failure costs. After much discussion by the top management and engineers, consensus reached to the points that 'Customer complaints' and 'Warranty claims' are the primary causes for this. A cost analysis based on the facts has been introduced. The table below provides data on expenditure for various external factors: (10)  
(CO1)  
(PO1)

Type of Cost	Dollars (Thousands)
Customer complaints	20
Returned goods	30
Retrofit costs	50
Warranty claims	90
Liability costs	10
Penalties	5
Customer goodwill	2

- (i) Explain the principle of the Pareto analysis from historical and practical perspectives.
- (ii) Convert the above data into a Pareto Table and draw a Pareto diagram. Then find the vital few and comment about the consensus reached by the management and your conclusions based on facts.

- b. i. What is a cause-and-effect (CE) diagram and why is it such an effective problem-solving tool? Briefly differentiate between the two types of CE diagrams. (15)  
(CO1)  
(PO1)
- ii. A customer placed a call to a mail-order catalog firm. Several times the customer dialed the phone and received a busy signal. Finally, the phone was answered electronically, and the customer was told to wait for the next available operator. Although it was a 1-800 number, he found it annoying to wait on the phone until his ear hurt. Yet he did not want to hang up for fear he would not be able to get through to the firm again. Using the problem statement "What makes a customer wait?" as your base, create a cause-and-effect diagram for the firm.
2. a. Zara, a 3<sup>rd</sup> year student at IUT just got her mid examination results for Mechanics of Machines. She was not satisfied with the results as this would reduce her total obtained grade and believed that there must be some problems with the way she was currently studying and eliminating them will get her better grades. In order to identify and systemically analyze these problems she utilized a PDCA cycle while asking herself the following questions: (13)  
(CO1)  
(PO1)
- 'What am I trying to accomplish?*  
*How can I know that a change is an improvement?*  
*What changes can I make that will result in improvement?'*
- What is a PDCA cycle? Construct a PDCA cycle for Zara while answering the above questions for her.
- b. Define BPR with an example. Distinguish between BPR and TQM and identify the major barriers to BPR. (12)  
(CO1)  
(PO1)
3. a. What is Process Capability Analysis? Discuss elaborately with diagrams about the five indices associated with process condition. (10)  
(CO2)  
(PO2)
- b. B-B-Q-King Drive-In Restaurant is considering a new marketing idea. At B-B-Q King, diners have the choice of dining inside or staying in their cars to eat. To serve those dining in their cars, carhops take the orders at the car and bring the food to the car when it's ready. Many people want fast service when they pull into the drive-in restaurant, but they also want more than a drive-through restaurant can offer. To try to meet their customers' expectations, B-B-Q-King Drive-In is proposing to promise to have a server at your car in two minutes with maximum one minute early or delay after your arrival at their drive-in. The current time for servers to reach the cars is given in the table below. Calculate the range for each of the subgroups containing five server times. Since the owners of B-B-Q-King Drive-In are interested in the combined performance of their servers and not the performance of any particular server, the subgroups contain times from each server. Use these calculated values to determine the process capability and the  $C_p$  and  $C_{pk}$  values. How well is the process performing when compared with the specifications promised to the customers? If the process is not performing as desired, advise the restaurant on how they can achieve the specifications required. (15)  
(CO2)  
(PO2)

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TABLE: Server-to-Car Times in Minutes

Subgroup Number	Server 1	Server 2	Server 3	Server 4	Server 5
1	2.5	2.4	2.3	2.5	2.1
2	2.5	2.2	2.4	2.3	2.8
3	2.4	2.5	2.7	2.5	2.5
4	2.3	2.4	2.5	2.9	2.9
5	2.3	2.6	2.4	2.7	2.2
6	2.6	2.4	2.6	2.5	2.5
7	2.7	2.6	2.4	2.4	2.5
8	2.4	2.3	2.5	2.6	2.4
9	2.5	2.2	2.3	2.4	2.7
10	2.4	2.4	2.3	2.7	2.4
11	2.5	2.4	2.5	2.5	2.3
12	2.4	2.3	2.4	2.2	2.1
13	2.5	2.5	2.4	2.5	2.7
14	2.5	2.4	2.3	2.3	2.6
15	2.4	2.3	2.3	2.4	2.8
16	2.6	2.7	2.4	2.6	2.9
17	2.0	2.3	2.2	2.7	2.5
18	2.2	2.4	2.1	2.9	2.6
19	2.3	2.5	2.6	2.4	2.3
20	2.3	2.5	2.6	2.6	2.5

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**TABLE B Factors for Computing Central Lines and  $3\sigma$  Control Limits for  $\bar{X}$ ,  $s$ , and  $R$  Charts**

Observations in Sample, $n$	CHART FOR AVERAGES						CHART FOR STANDARD DEVIATIONS						CHART FOR RANGES			
	Factors for Control Limits			Factor for Central Line	Factors for Control Limits			Factor for Central Line	Factors for Control Limits			Factors for Control Limits				
	$A$	$A_2$	$A_3$	$c_4$	$B_3$	$B_4$	$B_5$	$B_6$	$d_2$	$d_3$	$d_4$	$D_1$	$D_2$	$D_3$	$D_4$	
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	0	3.267	
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	0	2.574	
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	0	2.282	
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	0	2.114	
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	0	2.004	
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	0.076	1.924	
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	0.136	1.864	
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	0.184	1.816	
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	0.223	1.777	
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	0.256	1.744	
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	0.283	1.717	
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	0.307	1.693	
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	0.328	1.672	
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	0.347	1.653	
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	0.363	1.637	
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	0.378	1.622	
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	0.391	1.608	
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	0.403	1.597	
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	0.415	1.585	