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

Mid-Semester Examination

Course Number: IPE 4605

Course Title: Quality Control and Management

Summer Semester: 2022 - 2023

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. Imagine you are a manager at a manufacturing company that produces electronic gadgets. Recently, your team has been struggling to meet production deadlines, leading to delayed shipments and customer dissatisfaction. To address this issue, you decided to conduct a Pareto analysis to identify the most significant factors contributing to the production delays to use it to prioritize improvement efforts and allocate resources effectively. You gathered data on various potential causes of production delays over the past three months. After analyzing the data, you identified the following factors and their corresponding impact on production delays, measured in hours of delay.
- (10)  
(CO1)  
(PO1)

Causes	Delay in hours
Inadequate training of staff	150
Employee absenteeism	250
Machine breakdowns	300
Material shortages	200
Design changes requested by clients	100

Convert the above data into a Pareto table and perform a Pareto analysis to determine which factors are contributing the most to the production delays. Determine the vital few and comment on the results.

- b. Suppose you are a house manager, and recently many houses are facing the persistent issue of house paint peeling, which has become a recurring and unsightly concern for homeowners in your residential community. Construct a cause-and-effect diagram to identify the root causes contributing to this issue. Mention the type of CE diagram you used for the analysis.
- (8)  
(CO1)  
(PO1)
- c. The Animal Haven Corporation, a pet food company, would like to determine whether it could perform well against the standards for the Malcolm Baldrige National Quality Award. Animal Haven plans to apply for the award within the next few years. The purpose of this benchmarking experience is to see how they currently compare with the criteria and what areas they should focus on in the future. The company hopes to benefit from this type of compliance benchmarking experience before attempting to win the award. Provide details on the steps the company should take during the benchmarking process.
- (7)  
(CO1)  
(PO1)

2. a. Describe FMEA and elaborate on the various types of FMEA. Develop an exemplary FMEA form for the decreased engine performance and increased emissions in an automotive vehicle. (5+5=10)  
(CO1)  
(PO1)
- b. Define BPR with an example. Distinguish between BPR and TQM and identify the major barriers to BPR. (5+3+2=10)  
(CO1)  
(PO1)
- c. Explain QFD and its importance as a tool of TQM. (5)  
(CO1)  
(PO1)
3. a. Explain how it is possible to have a stable process that is incapable. How should process capability indices be interpreted? (4+3=7)  
(CO2)  
(PO2)
- b. At Johnson Robotics and Precision Systems (JRPS), a leading manufacturer in the robotics industry, precision and quality control are paramount. The team responsible for assembling shafts and armatures, critical components in their robotic systems, is focused on optimizing their operations to achieve superior process capability and has decided to employ six sigma methodologies. In order to conduct a comprehensive analysis of their current assembly processes the team plans to use the data gathered during a recent production run for roller shafts which will serve as the foundation for evaluating process capability and identifying opportunities for improvement. They have collected data for 15 subgroups of sample size 5 for a total of 75 measurements which is given in the table below. Customers expect a supplier to be capable of making their requested products to specifications and have provided the following requirements:  $12 \pm 0.05$ .  
From the table below calculate the sample standard deviation and mean for each of the subgroups (No need to copy the table). Use these calculated values to determine the process capability indices  $C_p$  and  $C_{pk}$  values. Explain how well the process is performing when compared with the specifications promised to the customers using figures. If the process is not performing as desired, advise on how they can achieve the specifications required.

*Table: Roller shaft diameter in mm*

Subgroup	1	2	3	4	5
1	11.950	12.000	12.030	11.980	12.010
2	12.030	12.020	11.960	12.000	11.980
3	12.010	12.000	11.970	11.980	12.000
4	11.970	11.980	12.000	12.030	11.990
5	12.000	12.010	12.020	12.030	12.020
6	11.980	11.980	12.000	12.010	11.990
7	12.000	12.010	12.030	12.000	11.980
8	12.000	12.010	12.040	12.000	12.020
9	12.000	12.020	11.960	12.000	11.980
10	12.020	12.000	11.970	12.050	12.000
11	11.980	11.970	11.960	11.950	12.000
12	11.920	11.950	11.920	11.940	11.960
13	11.980	11.930	11.940	11.950	11.960
14	11.990	11.930	11.940	11.950	11.960
15	12.000	11.980	11.990	11.950	11.930