


Name:	
Enrolment No:	

## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

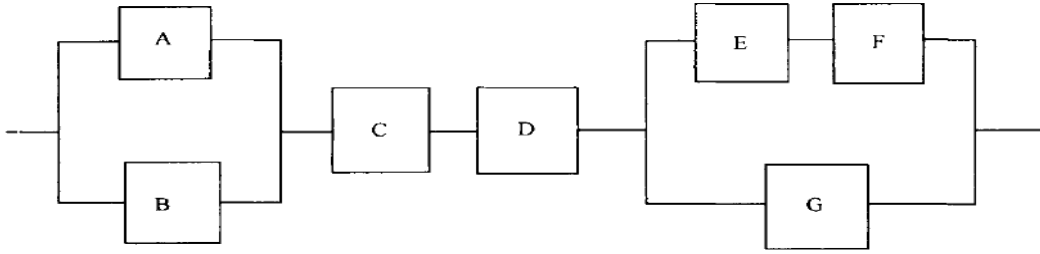
**End Semester Examination, May 2019**

Programme Name: <b>B. Tech Mechanical &amp; B. Tech Mechanical with Splz.</b>	Semester : <b>6th</b>
Course Name : <b>Quality Reliability &amp; Safety</b>	Time : <b>03 hrs</b>
Course Code : <b>MTEG 371</b>	Max. Marks : <b>100</b>
Nos. of page(s) : <b>04</b>	

### SECTION A

S. No.		Marks	CO																																																																																				
Q 1	A quality improvement program has been instituted in an organization to reduce total quality costs. Discuss the impact of such a program on prevention, appraisal, and failure costs.	5	CO1																																																																																				
Q2	List the corsby's philosophy of quality management.	5	CO1																																																																																				
Q3	<p>Every employee in a check-processing department goes through a four-month training period, after which the employee is responsible for their operation. The work of one employee who has been on the job for eight months is being studied. Table shows the number of errors and the number of items sampled over a period of two months. The first 16 samples were each chosen from 400 items, and the remaining 9 samples were each chosen from 300 items. Determine whether the employee's performance can be judged stable. Comment on the capability of the employee(P-Chart)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 15%;">Sample</th> <th style="width: 15%;">Errors</th> <th style="width: 15%;">Items Sampled</th> <th style="width: 15%;">Sample</th> <th style="width: 15%;">Errors</th> <th style="width: 15%;">Items Sampled</th> </tr> </thead> <tbody> <tr><td>1</td><td>12</td><td>400</td><td>14</td><td>18</td><td>400</td></tr> <tr><td>2</td><td>9</td><td>400</td><td>15</td><td>8</td><td>400</td></tr> <tr><td>3</td><td>13</td><td>400</td><td>16</td><td>6</td><td>400</td></tr> <tr><td>4</td><td>7</td><td>400</td><td>17</td><td>4</td><td>300</td></tr> <tr><td>5</td><td>6</td><td>400</td><td>18</td><td>6</td><td>300</td></tr> <tr><td>6</td><td>10</td><td>400</td><td>19</td><td>5</td><td>300</td></tr> <tr><td>7</td><td>14</td><td>400</td><td>20</td><td>8</td><td>300</td></tr> <tr><td>8</td><td>7</td><td>400</td><td>21</td><td>10</td><td>300</td></tr> <tr><td>9</td><td>5</td><td>400</td><td>22</td><td>7</td><td>300</td></tr> <tr><td>10</td><td>6</td><td>400</td><td>23</td><td>4</td><td>300</td></tr> <tr><td>11</td><td>4</td><td>400</td><td>24</td><td>5</td><td>300</td></tr> <tr><td>12</td><td>9</td><td>400</td><td>25</td><td>3</td><td>300</td></tr> <tr><td>13</td><td>11</td><td>400</td><td></td><td></td><td></td></tr> </tbody> </table>	Sample	Errors	Items Sampled	Sample	Errors	Items Sampled	1	12	400	14	18	400	2	9	400	15	8	400	3	13	400	16	6	400	4	7	400	17	4	300	5	6	400	18	6	300	6	10	400	19	5	300	7	14	400	20	8	300	8	7	400	21	10	300	9	5	400	22	7	300	10	6	400	23	4	300	11	4	400	24	5	300	12	9	400	25	3	300	13	11	400				5	CO2
Sample	Errors	Items Sampled	Sample	Errors	Items Sampled																																																																																		
1	12	400	14	18	400																																																																																		
2	9	400	15	8	400																																																																																		
3	13	400	16	6	400																																																																																		
4	7	400	17	4	300																																																																																		
5	6	400	18	6	300																																																																																		
6	10	400	19	5	300																																																																																		
7	14	400	20	8	300																																																																																		
8	7	400	21	10	300																																																																																		
9	5	400	22	7	300																																																																																		
10	6	400	23	4	300																																																																																		
11	4	400	24	5	300																																																																																		
12	9	400	25	3	300																																																																																		
13	11	400																																																																																					
Q4	Discuss briefly, the basic seven questions to be answered in implementing Reliability Centered Maintenance (RCM).	5	CO3																																																																																				

<b>SECTION B</b>			
Q 5	Construct a failure mode analysis flow chart and analysis the data of a centrifugal pump.	<b>10</b>	<b>CO4</b>
Q6	The diameter of a forged part has specifications of $120 \pm 5$ mm. A sample of 25 parts chosen from the process gives a sample mean of 122 mm with a sample standard deviation of 2 mm.  Find the Cpk index for the process, and comment on its value. What is the proportion of nonconforming parts assuming normality? If the target value is 120 mm, find the Cpm and Cpmk indices and comment on their values. If the process mean is to be set at the target value, how much of a reduction would occur in the proportion nonconforming?	<b>10</b>	<b>CO3</b>
Q7	A system consists of 5 independent components all connected in series, their failure rates are 0.0005, 0.0004, 0.0003, 0.0002 & 0.0001 per hour respectively. The specified failure rate of the series system is 0.002 per hour. Calculate the value of the failure rate to be allocated to each component.	<b>10</b>	<b>CO3</b>
Q8	Explain the safety features in applications below: <div style="text-align: center;">           (a) Oil &amp; gas industries.            (b) welding shop   <b>OR</b>             Explain the safety features in applications below:            (a) Machine shop            (b) Material handling         </div>	<b>10</b>	<b>CO5</b>
<b>SECTION-C</b>			
Q 9	Assume that the time to failure for each component has an exponential distribution. The failure rates are as follows: 0.0005, 0.0005, 0.0003, 0.0008, 0.0004, 0.006 and 0.0064/hour. Find the reliability of the system after 1000 hours. (a) What is the mean time to failure of the system? (b) If you had a choice of improving system reliability by modifying any two components, how would you proceed? (c) Suppose that component B is a standby component. Find the reliability of the system after 1000 hours. What is the mean time to failure? (d) Suppose that component B & G is a standby component. Find the reliability of the system after 1000 hours. What is the mean time to failure?	<b>20</b>	<b>CO3</b>



Q10

- i. The time to be seated at a popular restaurant is of importance. Samples of five randomly selected customers are chosen and their average and range (in minutes) are calculated. After 30 such samples, the summary data values are **(10 marks)**
- $$\sum_{i=0}^{30} \bar{X} = 306, \sum_{i=0}^{30} \bar{R} = 24$$
- (a) Find the  $\bar{X}$ - and  $\bar{R}$ -chart control limits.  
 (b) Find the  $1\sigma$  and  $2\sigma$   $\bar{X}$ - chart limits.  
 (c) The manager has found that customers usually leave if they are informed of an estimated waiting time of over 10.5 minutes. What fraction of customers will this restaurant lose?
- ii. The advertised weight of frozen food packages is 16 (oz) and the specifications are  $16 \pm 0.3$  oz. Random samples are of size 8 are selected from the output and weighted. The sample mean and standard deviation are calculated. Information on 25 such samples yields the following **(10 marks)**
- $$\sum_{i=0}^{25} \bar{X} = 398, \sum_{i=0}^{25} s = 3$$
- (a) Determine the centerlines and control limits for the  $\bar{X}$ - and  $s$ -charts.  
 (b) Estimate the process mean and standard deviation, assuming that the process is in control.  
 (c) Find the  $1\sigma$  and  $2\sigma$  control limits for each chart.  
 (d) What proportion of the output is nonconforming? Is the process capable?  
 (e) What proportion of the output weighs less than the advertised weight.

20

CO2

**OR**

- i. The time to deliver packaged containers by a logistics company is found from samples of size 4. The mean and standard deviation of delivery times is estimated to be 140 hours and 6 hours, respectively. **(10 marks)**
- (a) Find the  $2\sigma$  and  $3\sigma$  control limits for the average delivery time.  
 (b) Explain a type I and type II error specifically in this context.  
 (c) Suppose that Rules 1 and 3 are used simultaneously to detect out-of-

control conditions. Assuming independence of the rules, what is the overall probability of a type I error for  $3\sigma$  control limits?

(d) If the mean delivery time shifts to 145 hours, what is the probability of not detecting this by the second sample after the shift?

ii. The number of dietary errors is found from a random sample of 100 trays chosen on a daily basis in a health care facility. The data for 25 such samples are shown in Table – **c chart**.

(a) Construct an appropriate control chart and comment on the process.

(b) How many dietary errors do you predict if no changes are made in the process?

(c) Is the system capable of reducing dietary errors to 2, on average, per 100 trays, if no changes are made in the process? **(10 marks)**

Sample Number	Number of Dietary Errors	Sample Number	Number of Dietary Errors
1	9	14	8
2	6	15	8
3	4	16	7
4	7	17	6
5	5	18	4
6	6	19	12
7	16	20	7
8	8	21	6
9	7	22	8
10	9	23	6
11	3	24	8
12	6	25	5
13	10		