

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**  
**(MID SEMESTER EXAMINATION MO/2023)**

**CLASS : BTech**  
**BRANCH: PIE**

**SEMESTER : V**  
**SESSION : MO/2023**

**SUBJECT: PE326 METROLOGY & STATISTICAL QUALITY CONTROL**

**TIME : 02 Hours**

**FULL MARKS: 25**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates
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|--|--------|---------------|--------|----------------------|--------|---------------|-----------------|----|-------|----|----|----|--|--|--|
|  |        | CO            | BL     |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.1(a) Define the term 'Airy Point', state the condition to achieve it.  | (2)    | CO1           | BL1    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.1(b) Describe the procedure for deriving Line Standard to End Standard.  | (3)    | CO1           | BL2    |                      |        |               |                 |    |       |    |    |    |  |  |  |
|  |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.2(a) Draw the conventional Diagram of Limits and Fits and Explain the terms (i) Basic Size (ii) Fundamental Deviation  | [2]    | CO1           | BL2    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.2(b) In a limit system the following limits are specified for a shaft and a hole:  | [3]    | CO1           | BL4    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| <table border="0" style="display: inline-table; vertical-align: top;"><tr><td style="text-align: right;">-0.005</td><td></td><td style="text-align: right;">+0.010</td></tr><tr><td>shaft 30 mm diameter</td><td style="text-align: center;">Hole</td><td>3 mm diameter</td></tr><tr><td style="text-align: right;">-0.018</td><td></td><td style="text-align: right;">-0.00</td></tr></table> | -0.005 |               | +0.010 | shaft 30 mm diameter | Hole   | 3 mm diameter | -0.018          |    | -0.00 |    |    |    |  |  |  |
| -0.005   |        | +0.010        |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| shaft 30 mm diameter   | Hole   | 3 mm diameter |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| -0.018   |        | -0.00         |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Determine (i) shaft and hole limits (ii) shaft and hole tolerance (iii) maximum and minimum clearance.   |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| What do you understand by quality of performance? Discuss the factors that affect quality of performance.  |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.3(a) Describe statistical quality control and its components.  | [2]    | CO2           | BL1    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.3(b) In a class of 150 students marks obtained by students in tool design out of 100 is tabulated as below. Calculate the mean, median and mode of data given.   | [3]    | CO2           | BL4    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| <table border="0" style="display: inline-table; vertical-align: top;"><tr><td>Marks</td><td>0-20</td><td>20-40</td><td>40-60</td><td>60-80</td><td>80-100</td></tr><tr><td>No. of Students</td><td>15</td><td>32</td><td>54</td><td>30</td><td>19</td></tr></table>  | Marks  | 0-20          | 20-40  | 40-60                | 60-80  | 80-100        | No. of Students | 15 | 32    | 54 | 30 | 19 |  |  |  |
| Marks  | 0-20   | 20-40         | 40-60  | 60-80                | 80-100 |               |                 |    |       |    |    |    |  |  |  |
| No. of Students  | 15     | 32            | 54     | 30                   | 19     |               |                 |    |       |    |    |    |  |  |  |
|  |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.4(a) Describe various measures of dispersion and mention their usage   | [2]    | CO2           | BL1    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.4(b) What do you understand by type-I & type-II errors in control charts? When the sample size is increased, what will be its effect of type-I & type II error?  | [3]    | CO3           | BL4    |                      |        |               |                 |    |       |    |    |    |  |  |  |
|  |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| Q.5(a) The length of industrial filters is a quality characteristic of interest. Thirty samples, each of size 5, are chosen from the process. The data yields an average length of 110 mm, with the process standard deviation estimated to be 4 mm.   |        | CO3           | BL5    |                      |        |               |                 |    |       |    |    |    |  |  |  |
| a) Find type-I error and ARL?  |        |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
| b) If the processes mean shifts to 112 mm, what are the chances of detecting this shift by the first sample drawn after the shift?   | [2]    |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |
|  | [3]    |               |        |                      |        |               |                 |    |       |    |    |    |  |  |  |

:::20/09/2023 M:::