

Reg. No. 

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**B.E / B.TECH. DEGREE EXAMINATION, MAY 2023**

Sixth and Eighth Semesters

**OM18001 –STATISTICAL METHODS FOR ENGINEERS**

(Common to AI & DS, CSE, CHE, CVE, EEE, ECE, and MEC)

(Regulation 2018 / Regulation 2018A)

Use of Normal, t, F, and Chi-square tables are permitted

**TIME: 3 HOURS**

**MAX. MARKS: 100**

- CO 1** The students will have a fundamental knowledge of the concepts of descriptive statistics.
- CO 2** The students will have a notion of sampling distributions and to analyse and interpret the data based on the large sample tests.
- CO 3** Understand and characterize phenomena about variance and proportion and Goodness of fit.
- CO 4** Students would be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- CO 5** To enable the students to know the concepts of statistical Quality control theory and their applications on real time problems.

**PART- A (10 x 2 = 20 Marks)**  
(Answer all Questions)

- |  |           |                  |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
|--|-----------|------------------|---------|---------|---------|---------|----------|---------|----------|----------|----|----|---|----|----|----|----|----|--|--|
|  | <b>CO</b> | <b>RBT LEVEL</b> |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 1. Find the mode for the following distribution:   | 1         | 2                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td><i>x</i></td><td>0 – 10</td><td>10 – 20</td><td>20 – 30</td><td>30 – 40</td><td>40 – 50</td><td>50 – 60</td><td>60 – 70</td><td>70 – 80</td></tr><tr><td><i>f</i></td><td>5</td><td>8</td><td>7</td><td>12</td><td>28</td><td>20</td><td>10</td><td>10</td></tr></table> | <i>x</i>  | 0 – 10           | 10 – 20 | 20 – 30 | 30 – 40 | 40 – 50 | 50 – 60  | 60 – 70 | 70 – 80  | <i>f</i> | 5  | 8  | 7 | 12 | 28 | 20 | 10 | 10 |  |  |
| <i>x</i>   | 0 – 10    | 10 – 20          | 20 – 30 | 30 – 40 | 40 – 50 | 50 – 60 | 60 – 70  | 70 – 80 |          |          |    |    |   |    |    |    |    |    |  |  |
| <i>f</i>   | 5         | 8                | 7       | 12      | 28      | 20      | 10       | 10      |          |          |    |    |   |    |    |    |    |    |  |  |
| 2. Find the missing frequency ( <i>p</i> ) for the following distribution whose mean is 50.  | 1         | 3                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td><i>x</i></td><td>10</td><td>30</td><td>50</td><td>70</td><td>90</td></tr><tr><td><i>f</i></td><td>17</td><td><i>p</i></td><td>32</td><td>24</td><td>19</td></tr></table>   | <i>x</i>  | 10               | 30      | 50      | 70      | 90      | <i>f</i> | 17      | <i>p</i> | 32       | 24 | 19 |   |    |    |    |    |    |  |  |
| <i>x</i>   | 10        | 30               | 50      | 70      | 90      |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| <i>f</i>   | 17        | <i>p</i>         | 32      | 24      | 19      |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 3. A sample of 900 members has a mean 3.4 cm and standard deviation 2.61 cm. Is the sample from a large population of mean 3.25 cm and standard deviation. 2.61 cm?  | 2         | 3                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 4. Experience has shown that 20% of a manufactured product is of top quality. In one day's production of 400 articles, only 50 were found to be of top quality. Calculate the test statistic.  | 2         | 2                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 5. The mean life time of a sample of 25 fluorescent light bulbs produced by a company is computed to be 1570 hours with a S.D of 120 hours. The company claims that the average life of the bulbs produced by the company is 1600 hours. Compute the test statistic.   | 3         | 2                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 6. Write down the value of chi-square for a 2x2 contingency table with cell frequencies <i>a, b, c</i> and <i>d</i> .  | 3         | 2                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 7. Write down the ANOVA table for one way classification.  | 4         | 1                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 8. Write the basic assumption in analysis of variance.   | 4         | 1                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 9. If the average fraction defective of a large sample of products is 0.1537, calculate the control limits. (Given that sub-group size is 2,000)   | 5         | 2                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |
| 10. What do you mean by chance variation?  | 5         | 1                |         |         |         |         |          |         |          |          |    |    |   |    |    |    |    |    |  |  |

**PART- B (5 x 14 = 70 Marks)**

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|--|--------------|-----------|------------------|
|  | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| 11.(a) (i) Calculate the mean and standard deviation for the following table giving the age distribution of 542 members. | (7)          | 1         | 3                |

|                |       |       |       |       |       |       |       |
|----------------|-------|-------|-------|-------|-------|-------|-------|
| Age in years   | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 |
| No. of members | 3     | 61    | 132   | 153   | 140   | 51    | 2     |

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|--|--------------|-----------|------------------|
|  | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| (ii) An incomplete frequency distribution is given as follows. | (7)          | 1         | 3                |

|           |       |       |       |       |       |       |       |       |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
| Variable  | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | Total |
| Frequency | 12    | 30    | ?     | 65    | ?     | 25    | 18    | 229   |

Given that the median value is 46, determine the missing frequencies using the median formula.

**(OR)**

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|--|--------------|-----------|------------------|
|  | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| (b) (i) Calculate the median, lower quartile and the quartile coefficient of skewness from the following data: | (10)         | 1         | 3                |

|          |         |         |          |           |           |           |           |           |
|----------|---------|---------|----------|-----------|-----------|-----------|-----------|-----------|
| <i>x</i> | 70 – 80 | 80 – 90 | 90 – 100 | 100 – 110 | 110 – 120 | 120 – 130 | 130 – 140 | 140 – 150 |
| <i>f</i> | 12      | 18      | 35       | 42        | 50        | 45        | 20        | 8         |

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|---|--------------|-----------|------------------|
|   | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| (ii) The first four moments of a distribution about the value $X = 4$ of the variable are 1, 4, 10 and 45. Find $\mu_1, \mu_2, \mu_3, \mu_4, \beta_1$ and $\beta_2$ . | (4)          | 1         | 3                |

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|---|--------------|-----------|------------------|
|   | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| 12.(a) (i) The store keeper wanted to buy a large number of light bulbs of two brands A and B. He bought 100 bulbs from each brand and found by testing that brand A had mean life time of 1120 hours and standard deviation of 75 hours; brand B had mean lifetime of 1060 hours and standard deviation of 80 hours. Examine if the difference is significant. | (7)          | 2         | 3                |

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|---|--------------|-----------|------------------|
|   | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| (ii) In a random sample of 1000 people from city A, 400 are found to be consumers of wheat. In a sample of 800 from city B, 400 are found to be consumers of wheat. Does this data give a significant difference between the two cities as far as the proportion of wheat consumers is concerned? | (7)          | 2         | 3                |

**(OR)**

- |   |              |           |                  |
|---|--------------|-----------|------------------|
|   | <b>Marks</b> | <b>CO</b> | <b>RBT LEVEL</b> |
| (b) (i) Test the significance of the difference between the means of the samples, drawn from two normal populations with the same S.D. from the following data: | (7)          | 2         | 3                |

|          |      |      |     |
|----------|------|------|-----|
|          | Size | Mean | S.D |
| Sample 1 | 100  | 61   | 4   |
| Sample 2 | 200  | 63   | 6   |

(ii) In a sample of 300 units of a manufactured product, 65 units were found to be defective and in another sample of 200 units, there were 35 defectives. Is there significant difference in the proportion of defectives in the samples at the 5% level of significance? (7) 2 3

13.(a) (i) A random sample of 10 boys had the following I.Q's 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q of 100? (7) 3 3

(ii) Theory predicts that the portion of beans in four groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans the number in the four groups were 882, 313, 287 and 118. Does the experiment support the theory? (7) 3 3

(OR)

(b) Two random samples gave the following data. (14) 3 3

| Sample | Size | Mean | Variance |
|--------|------|------|----------|
| 1      | 8    | 9.6  | 1.2      |
| 2      | 11   | 16.5 | 2.5      |

Can we conclude that the two samples have been drawn from the same normal population?

14.(a) The following data represent the number of units of a product produced by 3 different workers using 3 different types of machines. (14) 4 3

| Workers | Machines |    |    |
|---------|----------|----|----|
|         | A        | B  | C  |
| X       | 8        | 32 | 20 |
| Y       | 28       | 36 | 38 |
| Z       | 6        | 28 | 14 |

Test (i) whether the mean productivity is the same for the different machine types, and (ii) whether the three workers differ with respect to mean productivity

(OR)

(b) In a Latin square experiment noted below, the yields is quintals per acre on the paddy crop carried out for testing the effect of five fertilizers A, B, C, D, E are given. Analyse the data for variations. (14) 4 3

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| B25 | A18 | E27 | D30 | C27 |
| A19 | D31 | C29 | E26 | B23 |
| C28 | B22 | D33 | A18 | E27 |
| E28 | C26 | A20 | B25 | D33 |
| D32 | E25 | B23 | C28 | A20 |

15.(a) Given below are the values of sample mean  $\bar{X}$  and sample range R for 10 samples, each of size 5. Draw the appropriate mean and range charts and comment on the state of control of the process. (14) 5 3

|       |    |    |    |    |    |    |    |    |    |    |
|-------|----|----|----|----|----|----|----|----|----|----|
| Mean  | 43 | 49 | 37 | 44 | 45 | 37 | 51 | 46 | 43 | 47 |
| Range | 5  | 6  | 5  | 7  | 7  | 4  | 8  | 6  | 4  | 6  |

(OR)

(b) The data given below are the number of defectives in 10 samples of 100 items each. Construct a p-chart and an np-chart and comment on the results. (14) 5 3

|                     |   |    |   |   |   |    |   |    |    |    |
|---------------------|---|----|---|---|---|----|---|----|----|----|
| Sample Number       | 1 | 2  | 3 | 4 | 5 | 6  | 7 | 8  | 9  | 10 |
| Number of defective | 6 | 16 | 7 | 3 | 8 | 12 | 7 | 11 | 11 | 4  |

**PART- C (1 x 10 = 10 Marks)**

(Q.No.16 is compulsory)

Marks CO RBT LEVEL

16. During one year a student received marks in various subjects as shown in the table below. Determine whether there is a significant difference between the student's grades at 0.01 level of significance. (10) 4 3

|             |    |    |    |    |    |
|-------------|----|----|----|----|----|
| Mathematics | 72 | 80 | 83 | 75 |    |
| Science     | 81 | 74 | 77 |    |    |
| English     | 88 | 82 | 90 | 87 | 80 |
| Economics   | 74 | 71 | 77 | 70 |    |

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