

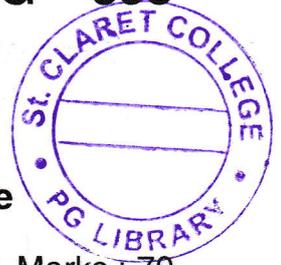


PG – 353

9

I Semester M.Sc. Examination, May 2024  
(CBCS Scheme) (2019 – 20 and Onwards)  
**FORENSIC SCIENCE**

**FS 105 : Essentials of Mathematics in Forensic Science**



Time : 3 Hours

Max. Marks : 70

- Instructions :** 1) Answer *all* Parts.  
2) **Draw** diagrams *wherever* necessary.

PART – A

Write short notes on the following :

(4×2=8)

1. Truncating and rounding a number.
2. Quadratic function is used in forensic science.
3. Hypergeometric distribution.
4. F-Test.

PART – B

Write critical notes on the following :

(4×8=32)

5. a) Discuss the units of measurements such as  
i) Mass ii) Volume iii) Density iv) Pressure.
- b) A spherical shotgun pellet has a diameter of 0.085 in and there are 450 such pellets to the ounce. Calculate  
i) the pellet diameter in mm  
ii) the mass of one pellet in g  
iii) the density of the pellet material in  $\text{kgm}^{-3}$ .  
The volume of a sphere is given by  $4\pi r^3/3$ .

OR

- a) In an exercise a group of students is asked to identify the number of points of second level details (minutiae) in a fragment of single fingerprint. Fifteen of them produce an answer and there are summarized as follows :  
12, 12, 10, 11, 9, 13, 12, 15, 11, 13, 7, 12, 11, 9, 10.  
Calculate the mean, median and mode values of this set of data and identify the inter-quartile points.
- b) Discuss the determining time since death by fly egg hatching.

P.T.O.



6. a) What are Accumulated Degree Hours (ADH) ? Compute total ADH for the following information of Green Bottle Fly raised at a constant temperature of 70 degree F.

| From          | To            | Temperature (degree in F) | Hours |
|---------------|---------------|---------------------------|-------|
| Egg           | First instar  | 70                        | 23    |
| First instar  | Second instar | 70                        | 27    |
| Second instar | Third instar  | 70                        | 22    |
| Third instar  | Pupae         | 70                        | 130   |
| Pupae         | Adult         | 70                        | 143   |

- b) Express how trigonometry used in bloodstain analysis. Crime scene investigators noted blood spatter on the floor of the kitchen. The investigators drew lines of convergence and measured the distance from the area of convergence to the front edge of a drop of blood. That distance was recorded as 5.75 feet. After measuring the length and width of the blood droplet and using the law of sines, it was determined that the angle of impact was 27 degrees. The police wanted to determine the point of origin, or the height from the floor where the person was bleeding.

OR

- a) What is Ricochet analysis ? A burglar gain access to an up stair window by using a ladder. If the height of the window is 4.3 m above the ground and impression mark from the ladder are found 1.2 m out from the wall. Calculate the length of the ladder and the angle it makes to the ground.
- b) Distinguish between acidic and alkaline. The pH of the fluid in a human stomach varies between about 1 and 4. Is the environment in our stomach acidic or alkaline ?
7. a) Define conditional Probability and state the addition and multiplication theorem of probability for any two events.
- b) Consider death cases from police record, where 2% of the deaths are murdered. If 60 such cases are investigated by forensic department, use binomial probability distribution to calculate the probability that at most 4 are murdered.

OR

- a) State the Bayes' theorem and how Bayes' theorem used in forensic science.
- b) Fit the linear equation for the following data and forecasting for 2023 years the number of crimes i.e. Offence against persons that will be likely to occur.

| Year                     | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|--------------------------|------|------|------|------|------|------|------|------|------|------|
| Offences Against Persons | 200  | 192  | 350  | 207  | 176  | 207  | 242  | 125  | 187  | 393  |



- 8. a) Explain the role of Chi-square test related to forensic science.
- b) What are two glass samples? Five measurements of aluminum concentration in crime scene sample .751, .659, .746, .772, .722 and five measurements of aluminum concentration in recovered sample .752, .739, .695, .741, .715. Perform the t-test for testing whether there is any significant difference between the aluminum concentration in crime scene sample and recovered sample (table value at 5% level of significant = 1.86).

OR

- a) A psychologist claims that the children who have never faced a crime have more IQ. A random sample of thirty children IQ scores have a mean score of 112. Is there sufficient evidence to support the psychologist's claim? The mean population IQ is 100 with a standard deviation of 15 (use 5% level of significance).
- b) Discuss the role of likelihood ratio test and weight of evidence in evaluation of evidence.

PART – C

Answer the following :

(2×15=30)

- 9. a) What are the stages of statistical investigation? Mention the application of statistics in forensic science.
- b) The data on distribution of type of suicide among 300 adolescents. Graphically display the data in percentages by bar and cluster bar diagram and analyze.

| Method of suicide             | Male       | Female     |
|-------------------------------|------------|------------|
| Firearm                       | 40         | 34         |
| Jump from height              | 20         | 25         |
| Hanging                       | 77         | 73         |
| Poisoning                     | 13         | 14         |
| Burning                       | 1          | 1          |
| Drinking corrosive substances | 0          | 2          |
| <b>Total</b>                  | <b>151</b> | <b>149</b> |

OR



- a) Discuss the following mathematical applications in forensic investigations.
    - i) Hair is it animal or human ?
    - ii) Microscopic measurement of Pollen
    - iii) Blood Spatter analysis
    - iv) Time of Death Estimation
    - v) Insects and time of death
    - vi) Chromatography.
  - b) At 9 am on February 29, 2024, a body was found in room 327 at the university centre. The room is kept at a constant temperature of 72F. The medical examiner was called and he arrived in 8 minutes. The first thing he did was to take the temperature of the body, it was 83F. Thirty minutes later the temperature of the body was taken again and it was now 78F. Help the police by telling them when the person was murdered.
10. a) Suppose that the reliability of a HIV test is specified as follows :  
 Of people having HIV, 90% of the tests detect the disease but 10% go undetected. Of people free of HIV, 99% of the tests are judged HIV–ive but 1% are diagnosed as showing HIV+ive. From a large population of which only 0.1% has HIV, one person is selected at random, given the HIV test, and the pathologist reports him/her as HIV+ive. What is the probability that the person actually has HIV ?
- b) Write the applications and characteristics of the hypergeometric and normal distribution.

OR

Define null and alternative hypothesis. Analyze the following data by using the statistical technique called Chi-square analysis. Test whether there is any significant differences between the crimes committed.

| Year | Offences against persons | Offences against property | Offences against others |
|------|--------------------------|---------------------------|-------------------------|
| 2013 | 200                      | 25                        | 290                     |
| 2014 | 192                      | 40                        | 380                     |
| 2015 | 350                      | 22                        | 170                     |
| 2016 | 207                      | 19                        | 1120                    |
| 2017 | 176                      | 12                        | 40                      |
| 2018 | 207                      | 102                       | 125                     |
| 2019 | 242                      | 28                        | 150                     |
| 2020 | 125                      | 16                        | 70                      |
| 2021 | 187                      | 21                        | 87                      |
| 2022 | 393                      | 33                        | 156                     |

(The tabulated value from  $\chi_{0.05}^2$ , 18 = 28.886).