

Total No. of Questions : 6]

SEAT No. :

P683

[5217]-4

[Total No. of Pages : 3

F.Y.B.Sc. (Biotechnology)

MATHEMATICS AND STATISTICS

**Bb-104 : Mathematical and Statistical Methods for Biologists
(2013 Pattern)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of non-programmable scientific calculator is allowed.*
- 4) *Solve each section on separate answer paper.*

SECTION-I

Q1) Attempt each of the following. **[4 × 2 = 8]**

- a) Find eigenvalues of $A = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}$. Hence write eigenvalues of A^3 .
- b) Check for exactness, the following differential equation:
 $(3x^2y - 6x) dx + (x^3 + 2y) dy = 0$
- c) Find real and imaginary parts of $Z = \frac{i^4 + i^2 + 1}{i^7 + i^3}$.
- d) Use E-definition to prove that $\lim_{n \rightarrow \infty} \frac{1}{n+1} = 0$.

Q2) Attempt any four of the following. **[4×4=16]**

- a) Find rank of the following matrix. $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 3 & 4 & 5 & 2 \\ 2 & 3 & 4 & 0 \end{bmatrix}$
- b) Find the stationary point and determine the nature of the following function. $f(x, y) = x^2 + 3xy + y^2$.
- c) Test the convergence of the series $\sum_{n=1}^{\infty} \frac{n^n}{e^n}$.
- d) Find integrating factor of the following differential equation and hence find its solution. $(1 + xy) y dx + (1 - xy) x dy = 0$.

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- e) Solve the following system of linear equations.
 $2x + 4y + z = 3$
 $3x + 2y - 2z = -2$
 $x - y + z = 6$
- f) Check whether the following vectors are linearly dependent in \mathbb{R}^4 .
 $\{(1, 0, 1, 2), (0, 1, 1, 2), (1, 1, 1, 3)\}$

Q3) Attempt any two of the following. **[2 × 8 = 16]**

- a) Show that the following matrix is diagonalizable. Also find P that diagonalizer A.

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

- b) i) If $u = \log(x^2 + y^2)$, then show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$.
- ii) Find the value of $(1+i\sqrt{3})^5 + (1-i\sqrt{3})^5$.
- c) Solve the differential equation $\frac{dy}{dx} = \frac{x+y-3}{2(x+y)}$.
- d) Let $x_1 = \sqrt{3}, x_n = \sqrt{3x_{n-1}}, n \geq 2$. Show that $\{x_n\}$ is monotonically increasing and bounded above. Also find $\lim_{n \rightarrow \infty} \{x_n\}$.

SECTION-II

Q4) Attempt each of the following. **[4 × 2 = 8]**

- a) Define normal distribution also state its mean and variance.
- b) Explain the term sample with illustration.
- c) Explain the concept of multiple correlation.
- d) Compute Q_1 and Q_3 for given data 10, 15, 13, 16, 19, 7, 2, 9.

Q5) Attempt any four of the following. **[4 × 4 = 16]**

- a) If three digit number is formed out of 4,6,7,8,5 without repeating any digit, find probability that it is divisible by 5.
- b) Compute coefficient of variation for given data, 7,5,3,6,9.
- c) Write a short note on poisson distribution.

- d) IF $P(A) = \frac{1}{2}$ $P(B) = \frac{2}{5}$, $P(A \cap B) = \frac{1}{3}$. Find
- i) $P(A \cup B)$
 - ii) $P(A' \cap B')$
- e) Calculate coefficient of correlation by using given data:
 $n = 20$, $\sum x = 80$, $\sum y = 40$, $\sum xy = 480$, $\sum R^2 = 1680$, $\sum y^2 = 320$.
- f) Define :
- i) Statistic.
 - ii) Null hypothesis.
 - iii) Standard error.
 - iv) Critical region.

Q6) Attempt any two.

[2 × 8 = 16]

- a) Explain the test procedure for testing equality of two population means for paired and unpaired data.
- b) Compute mean, median and mode for the following frequency distribution.

Class	0-10	10-20	20-30	30-40	40-50
Frequency	5	15	25	18	17
- c) What do you mean by analysis of variance technique.
- d) Describe tests based on χ^2 distribution.

