



Name : .....  
Roll No. : .....  
Invigilator's Signature : .....

**CS/B.Sc(H)BT/GE/MICRO/MOL-BIO/SEM-1/BMT-104/2011-12**

**2011**

**BIO-MATHEMATICS – I**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

i) The modulus of the complex number  $\frac{1+i}{1-i}$  is

a) 2

b) 1

c)  $\sqrt{2}$

d)  $\frac{1}{\sqrt{2}}$ .

ii) The modulus of the complex number  $\frac{1-i\sqrt{3}}{1+i\sqrt{3}}$  is

a) 1

b) 2

c) 3

d) 4.

iii) If  $x+iy$  and  $-2+3i$  are two conjugate complex numbers, then the values of  $x$  and  $y$  are

a)  $x=2, y=3$

b)  $x=-2, y=3$

c)  $x=2, y=-3$

d)  $x=-2, y=-3$ .



- iv) The value of  $\log_{\sqrt{7}} 343$  is
  - a) 6
  - b) 5
  - c) 4
  - d) 3.
  
- v) If  $\log_x 81 = 4$ , then the value of  $x$  is
  - a) 2
  - b) 3
  - c)  $\sqrt{3}$
  - d) 4.
  
- vi) If  $\log_{10}(7x - 5) = 2$ , then the value of  $x$  is
  - a) 5
  - b) 15
  - c) 10
  - d) 20.
  
- vii) The number of terms in the expansion  $\left(x - \frac{1}{x}\right)^{10}$  is
  - a) 11
  - b) 10
  - c) 9
  - d) 8.
  
- viii) If the coefficients of  $(4r + 5)$ th term and  $(2r + 1)$ th term in the expansion of  $(1 + x)^{10}$  are equal, then the value of  $r$  is
  - a) 1
  - b) 2
  - c) 3
  - d) 4.
  
- ix) The value of the determinant  $\begin{vmatrix} 2 & 3 & 4 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \end{vmatrix}$  is
  - a) 1
  - b) 0
  - c) 2
  - d) 3.
  
- x) If  $\begin{vmatrix} x & 4 & -2 \\ 4 & x & -2 \\ 4 & -2 & x \end{vmatrix} = 0$  then the values of  $x$  are
  - a) 4, 2
  - b) -4, -2
  - c) 4, -2
  - d) -4, 2.



xi) If  $A = \begin{bmatrix} 2 & 3 \\ 6 & 5 \end{bmatrix}$  then  $A^2$  is

a)  $\begin{bmatrix} 22 & 21 \\ 42 & 43 \end{bmatrix}$

b)  $\begin{bmatrix} 22 & 42 \\ 21 & 43 \end{bmatrix}$

c)  $\begin{bmatrix} 21 & 22 \\ 43 & 42 \end{bmatrix}$

d)  $\begin{bmatrix} 42 & 43 \\ 22 & 21 \end{bmatrix}$ .

xii) If  $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$  then the values of  $x$  and  $y$  are

a)  $x = 1, y = -1$

b)  $x = 1, y = 1$

c)  $x = -1, y = 1$

d)  $x = -1, y = -1$ .

xiii) The value of  $\lim_{x \rightarrow 2} \frac{x - \sqrt{3x - 2}}{x^2 - 4}$  is

a)  $\frac{1}{4}$

b)  $\frac{1}{16}$

c)  $\frac{1}{8}$

d)  $\frac{1}{2}$ .

xiv) The value of  $\lim_{x \rightarrow 0} \frac{\sqrt{1+ax} - \sqrt{1-ax}}{x}$  is

a)  $a$

b)  $2a$

c)  $\frac{1}{2}a$

d)  $3a$ .

xv) If  $y = e^{4x}$ , then  $\frac{dy}{dx}$  at  $x = 0$  is

a) 0

b) 4

c) 1

d) 2.

xvi) If  $y = \sqrt{x}$  then  $\frac{dy}{dx}$  at  $x = 2$  is

a)  $\frac{1}{2}$

b)  $\frac{1}{\sqrt{2}}$

c)  $\frac{1}{2\sqrt{2}}$

d)  $\frac{1}{4\sqrt{2}}$ .



xvii) The value of  $\int_1^2 x^2 dx$  is

- |                  |                    |
|------------------|--------------------|
| a) $\frac{8}{3}$ | b) $\frac{1}{3}$   |
| c) $\frac{7}{3}$ | d) $\frac{4}{3}$ . |

xviii) The value of  $\int_2^3 e^{2x} dx$  is

- |                              |                             |
|------------------------------|-----------------------------|
| a) $\frac{1}{2}e^4(e^2 - 1)$ | b) $e^2 - 1$                |
| c) $\frac{1}{2}(e^2 - 1)$    | d) $\frac{1}{2}(e^4 - 1)$ . |

xix) The order and degree of the differential equation

$$\left(\frac{d^2 y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 + y = 3x^4 \text{ is}$$

- |         |          |
|---------|----------|
| a) 2, 2 | b) 1, 3  |
| c) 3, 1 | d) 2, 1. |

xx) The integrating factor of the differential equation

$$\frac{dy}{dx} - \frac{2y}{x} = x^2 \text{ is}$$

- |                  |                      |
|------------------|----------------------|
| a) $\frac{1}{x}$ | b) $\frac{1}{x^2}$   |
| c) $\frac{2}{x}$ | d) $\frac{1}{x^3}$ . |

xxi) The integrating factor of the differential equation

$$\frac{dy}{dx} - y = x \text{ is}$$

- |             |           |
|-------------|-----------|
| a) $x$      | b) $e^x$  |
| c) $e^{-x}$ | d) $-x$ . |





**GROUP - C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) If  $A = \begin{bmatrix} 3 & 2 & 1 \\ 1 & 1 & 1 \\ 5 & 1 & -1 \end{bmatrix}$ , find  $A^{-1}$ .

b) Find the rank of the matrix  $A = \begin{bmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 5 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{bmatrix}$  by diagonalisation method.

c) Solve by Cramer's rule :

$$x + 2y + 3z = 6$$

$$2x + 4y + z = 7$$

$$3x + 2y + 9z = 14$$

8. a) A function  $f(x)$  is defined by

$$f(x) = x^2, \text{ when } x < 1$$

$$= 2 \cdot 5, \text{ when } x = 1$$

$$= x^2 + 2, \text{ when } x > 1.$$

Is  $f(x)$  continuous at  $x = 1$  ?

b) If  $y = \sqrt{2x} - \sqrt{\frac{2}{x} + \frac{x+4}{4-x}}$ , show that the value of

$$\frac{dy}{dx} \text{ at } x = 2 \text{ is } \frac{11}{4}.$$

c) Find  $\frac{dy}{dx}$  if  $x^y = y^x$ .



9. a) Test whether Rolle's theorem is applicable or not for the function  $f(x) = 1 - |x - 1|$  in  $0 \leq x \leq 2$ .
- b) In the Mean value theorem  $f(b) - f(a) = (b - a)f'(c)$  where  $a < c < b$ , find the value of  $c$  if  $f(x) = \sqrt{x}$ ,  $a = 4$ ,  $b = 9$ .
- c) Verify Euler's theorem for the function  
 $f(x, y) = ax^2 + 2hxy + by^2$ .
10. a) Integrate  $\int x^2 \sqrt{a^3 + x^3} dx$
- b) Evaluate  $\int_1^{e^2} \frac{dx}{x(1 + \log x)^2}$
- c) Find the area of the segment cut off from  $y^2 = 4x$  by the line  $y = x$ .
11. a) Solve :  $\frac{dy}{dx} = \frac{x^2 + y^2}{2xy}$
- b) Solve :  $\frac{dy}{dx} + xy = x$
- c) The population of a country increases at the rate proportional to the number of inhabitants. If the population doubles in 30 years, in how many years will it be triple ?

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