PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2023
(Fourth Semester)

Branch – **MICROBIOLOGY**

MATHEMATICS FOR LIFE SCIENCES

Time: Three Hours   Maximum: 50 Marks

SECTION-A (5 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks   (5 x 1 = 5)

1   The solution of $a(xdy + 2ydx)xy\,dy$ is _____.
    (i) $\log(xy^2) = y + c$ (ii) $a\log(xy^2) = y + c$
    (iii) $a\log(yx^2) = y + c$ (iv) $\log(yx^2) = y + c$

2   _____ equation represent a cycloid having cusp at the origin.
    (i) $x = C(\theta - \sin\theta)$ (ii) $x = C(\theta + \sin\theta)$
    (iii) $x = C(\theta - \cos\theta)$ (iv) $x = (-\cos\theta)$

3   The error in Simpson's formula is of order _____ .
    (i) h (ii) h^2
    (iii) h^3 (iv) h^4

4   Second order Runge – Kutta method is exactly same as _____ method.
    (i) Euler's   (ii) Modified Euler's
    (iii) Improved Euler's   (iv) Trapezoidal

5   A plot of $[S]/v$ versus $[S]$ is linear with a slope of _____.
    (i) $1/V_{max}$ (ii) V_{max}
    (iii) $-1/K_m$ (iv) $-1/V_{max}$

SECTION - B (15 Marks)
Answer **ALL** Questions
ALL Questions Carry **EQUAL** Marks   (5 x 3 = 15)

6   a Solve $\frac{dy}{dx} + y\cos x = \frac{1}{2}\sin 2x$.

OR

    b Solve $(1 + xy^2)dx + (1 + x^2y)dy = 0$.

7   a If in a culture of yeast, the active ferment doubles itself in three hours, by what ratio will it increases in 15 hours, on the assumption that the quantity increases at a rate proportional to itself?

OR

    b Find the time required to empty a cylindrical tank 1 metre in diameter and 4 metres long through a hole 5 cm. diameter if the tank is initially full and its axis is vertical.

8   a Find $\frac{dy}{dx}$ at $x = 1.15$ from the table of values of x and y given below:

x :	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y :	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

OR

    b Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule with $h = 0.2$.

Cont...

9 a Using Euler's method *solve* $y' = x + y$, $y(0) = 1$, *for* $x = 0.0(0.2)(1.0)$.

OR

b Find $y(0.1)$, given $y' = x^2 + y$, $y(0) = 1$ using Improved Euler's method.

10 a What fraction of V_{max} is observed at $[S] = 4 K_m$, $[S] = 5 K_m$, $[S] = 10 K_m$.

OR

b Estimate k, the first-order rate constant, for an enzyme preparation with

a V_{max} of μ moles X liter^{-1}X min^{-1} under the given experimental

conditions. $K_m = 2 X 10^{-6} M$.

SECTION -C (30 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 x 6 = 30)

11 a Solve $\frac{dy}{dx} = \frac{x+2y-3}{2x+y-3}$.

OR

b Solve $\frac{dy}{dx} - y \, tanx = \frac{sinx \, cos^2x}{y^2}$.

12 a A tank contains 1,000 litres of brine in which 400 grams of salt are dissolved . Fresh water runs into the tank at the rate of 8 litres per minute and the mixture (kept uniform by continuous stirring runs out at the same rate). How long will it be before only 200 grams of salt are left in the tank?

OR

b In the circuit described by equation $L\frac{dI}{dt} + RI = E$, show that
i) Ohm's law is satisfied whenever the current is a maximum or a minimum
ii) the e.m.f is increasing when the current is at a minimum and decreasing when it is at a maximum.

13 a Find the first two derivatives of $(x)^{1/3}$ at $x = 50$ from the table given below:

x :	50	51	52	53	54	55	56
y :	3.6840	3.7084	3.7325	3.7563	3.7798	3.8030	3.8259

OR

b Dividing the range into 10 equal parts, evaluate $\int_0^\pi sinx \, dx$ by Simpson's rule.

14 a solve the equation $\frac{dy}{dx} = 1 - y$, given $y(0) = 0$ by using Modified Euler's method and tabulate the solutions at $x = 0.1$ & 0.2.

OR

b Apply the fourth order Runge-Kutta method, *solve* $y' = x + y$, $y(0) = 1$, *for* $x = 0.2$.

15 a The equilibrium constant for the reactions $S \rightleftharpoons P$ is 5. Suppose we have a mixture of $[S] = 2 X 10^{-4} M \, and \, [P] = 3 X 10^{-4} M$. $K_{ms} = 3 X 10^{-5}M$, $V_{maxf} = 2 \mu moles X liter^{-1}X min^{-1}$, V_{maxr} 4μ moles $X liter^{-1}X min^{-1}$. At what initial velocity will the reaction start towards equilibrium?

OR

b An enzyme was assayed at an initial substrate concentration of $2 X 10^{-5}M$. In 6 min, half of the substrate had been used. The K_m for the substrate is $5 X 10^{-5}M$. Calculate i) k ii) the concentration of product produced by 15 min.

Z-Z-Z   END