PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2022
(Fourth Semester)

Branch – **MICROBIOLOGY**

MATHEMATICS FOR LIFE SCIENCES

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 x 1 = 10)

1. The linear equation is of the form
(i) $\frac{dy}{dx}+Py=0$ (ii) $\frac{dy}{dx}+Py=Q$ (iii) $\frac{dx}{dy}+Qy=P$ (iv) $\frac{dx}{dy}+Qy=0$

2. The necessary condition for the differential equation $Mdx+Ndy=0$ to be exact if_____
(i) $\frac{\partial M}{\partial y}+\frac{\partial N}{\partial x}=0$ (ii) $\frac{\partial M}{\partial y}-x\frac{\partial N}{\partial y}=0$ (iii) $\frac{\partial M}{\partial y}=\frac{\partial N}{\partial x}$ (iv) $\frac{\partial M}{\partial y}\neq\frac{\partial N}{\partial x}$

3. Which one of the following is Torricelli's law____?
(i) $v=c\sqrt{2gh}$ (ii) $v=\sqrt{2ghc}$ (iii) $v=2ghc$ iv) $v=\sqrt{2gh}$

4. Newton's second law of motion is____
(i) $F=\frac{d}{dt}(mgh)$ (ii) $F=\frac{d}{dt}(mv)$ (iii) $F=\frac{d}{dt}\left(\frac{1}{2}mv^2\right)$ (iv) $F=\frac{d}{dt}(mg)$

5. Error in the trapezoidal formula is of the_____
(i)Order of k^2 (ii) Order of v^2 (iii) Order of h^2 (iv) Order of 0

6. Error in the Simpson's formula is of the_____
(i) $O(h^2)$ (ii) $O(h^3)$ (iii) $O(h)$ (iv) $O(h^4)$

7. When y=0 and x=0, the exact solution of the differential equation $\frac{dy}{dx}=1-y$ is_____
(i) $y=1-e^x$ (ii) $y=1-e^{-x}$ (iii) $y=1-x^e$ (iv) $y=1-x^{-e}$

8. The Euler algorithm is_____
(i) $y_{m+1}=y_m+hf(x_m,y_m)$ (ii) $y_{m+1}=y_0+hf(x_m,y_m)$
(iii) $y_{m+1}=y_m+hf(x_0,y_0)$ (iv) $y_{m+1}=y_1+hf(x_m,y_m)$

9. Henri-Michaelis-Menten equation is_____
(i) $\frac{v}{V_{Max}}=\frac{[S]}{K_S+[S]}$ (ii) $\frac{K}{V_{Max}}=\frac{[S]}{K_S+[S]}$ (iii) $\frac{v}{V_{Max}}=\frac{[K]}{K_S+[S]}$ (iv) $\frac{V}{V_{Max}}=\frac{[S]}{K_S+[S]}$

10. First order kinetics equation is_____
(i) $\frac{V_{\min}[S]}{K_m+[S]}$ (ii) $\frac{V_{mac}[S]}{K_m+[S]}$ (iii) $\frac{V_{mac}[S]}{K_m-[S]}$ (iv) $\frac{V_{\min}[S]}{K_m-[S]}$

SECTION-B (25 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (5x5=25)

11 a. Solve: $\frac{dy}{dx}+\left(\frac{1-y^2}{1-x^2}\right)^{1/2}=0$.

(Or)

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

12 a. A tank contains 100 litres of fresh water.2 litres per minute of brine, run in, each containing 1 gram of salt and the mixture runs out at 1 litre per minute .Find the amount of salt present when the tank contains 150 litres of water.

(Or)

Cont...

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.

13 a. Evaluate $\int_0^1 \frac{1}{1+x}dx$ correct to three decimal places by Trapezoidal rule with h= 0.5

(Or)

b. Compute the value of $\log_e 2$ using Simpson's rule from the formula $\log_e 2 = \int_1^2 \frac{dx}{x}$ .Take 4 equal intervals in (1, 2)

14 a.Using Euler's method solve $\frac{dy}{dx} = 1 + xy$ with $y(0) = 2$ .Find y (0.1), y (0.2) and y(0.3)?

(Or)

b.Evaluate the solution at x=0.1, 0.2 of the problem by second order Runge-Kuta method. $y' = \frac{1}{2}(1+x)y^2, y(0) = 1$.

15 a. Estimate k, the first order rate constant, for an enzyme preparation with a V_{max} of 4.6μ Moles x liter^{-1} x min^{-1} under given experimental conditions Km= 2 x 10^{-6}M.

(Or)

b. An enzyme was assayed at an initial substrate concentration of 2 x10^{-5}M.In 6 min; half of the substrate had been used. The K_m for the substrate is 5 x10^{-3}M.Calculate (a) k, (b) Vmax

SECTION-C (40 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (5x8=40)

16 a. Solve: $x\frac{dy}{dx} + y\log x = e^x x^{1-\frac{1}{2}\log x}$

(Or)

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

17 a. If a bead be released at the origin and slides down the wire $x = a(\theta - \sin\theta)$ and $y = a(1-\cos\theta)$, show that the time taken to reach the point $(\pi a, 2a)$ at the vertex is $\pi\left(\frac{a}{g}\right)^{\frac{1}{2}}$.

(Or)

b. A spherical rain drop, starting from rest, falls under the influence of gravity. If it gathers in water vapour (assumed at rest) at a rate proportional to its surface and if its initial radius is 0, show that it falls with constant acceleration $\frac{g}{4}$.

18 a. From the following table values of x and y, find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for x=1.05 by using suitable Formula:

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. From the following table values of x and y, find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for x=1.15 by using Stirling's formula.

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

19 a. Given $\frac{dy}{dx} = x^2 + y, y(0) = 1$, determine y (0.02), y (0.04) and y (0.06) using Euler's Modified method.

(Or)

b. Apply fourth order Runge-Kutta method, to find an approximate value of y when x=0.2, given that $y' = x + y$, y (0) =1.

20 a. Derive the Haldane relationship between kinetic constants and equilibrium constants.

(Or)

b. Explain methods of plotting enzyme kinetics data.

Z-Z-Z END