PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2024
(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 the linear equation $\frac{dy}{dx} + Py = Q$ where P and Q are functions of x only
   is _____

   (i) $e^{\int Pdx} = \int Qe^{\int Pdx}dx + c$

   (ii) $e^{\int Qdx} = \int Pe^{\int Qdx}dx + c$

   (iii) $e^{\int Pdy} = \int Qe^{\int Pdy}dy + c$

   (iv) $e^{\int Qdy} = \int Pe^{\int Qdy}dy + c$

2. By the Torricelli's law, the velocity related to the height is_____

   (i) $v = \frac{1}{\sqrt{2gh}}$

   (ii) $v = \frac{c}{\sqrt{2gh}}$

   (iii) $v = c\sqrt{2gh}$

   (iv) $v = \sqrt{\frac{1}{2gh}}$

3. Identify the value of $\int_{0}^{1} \frac{1}{1+x^2}dx$ using Simpson's rule with h = 0.2

   (i) 0.7837

   (ii) 1.7837

   (ii) 0.5837

   (iv) can't use this rule

4. Which method given below provides the result much nearer to the solution curve of exact result?
   (i) Modified Euler's method
   (ii) Euler's method
   (iii) Improved Euler's method
   (iv) Runge-Kutta method

5. Indicate the intercept on the [s]/v axis corresponding to Hanes-Woolf plot
   (i) K_m (ii) V_{max} (iii) K_m/V_{max} (iv) $K_m V_{max}$

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

6. a. Solve $(x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$.

   (OR)

   b. Solve $dy/dx - y \tan x = \sin x \cos^2 x / y^2$

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

   (OR)

   b. If the air resistance on a falling body of mass m exerts a retarding force proportional to the square of the velocity, the equation of motion in $dv/dt = g - cv^2$ where c = k/m. If v = 0 when t = 0, find v as a function of t. What is the terminal velocity?

8. a. From the values in the table given below, find the value of sec 31° using numerical differentiation

θ	31	32	33	34
tan θ	0.6008	0.6249	0.6494	0.6745

   (OR)

b. Evaluate $\int_0^1 \dfrac{1}{1+x}\,dx$ correct to three decimal places by trapezoidal rule with h=0.5.

9. a. Solve by Euler method $y' = -y, y(0) = 1$ and find y(0.04).

(OR)

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

10. a. The equilibrium constant for the reaction S $\Leftrightarrow$ 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_{max_f} = 2 μ moles x liter^{-1} x min^{-1}, V_{max_r} = 4μ moles x liter^{-1} x min^{-1}. At what initial velocity will the reaction start towards equilibrium?

(OR)

b. Discuss about Haldane relationship between kinetic constants and equilibrium constants.

SECTION - C (30 Marks)
Answer ALL Questions
ALL Questions Carry EQUAL Marks   (5 x 6 = 30)

11. a. Solve the non-homogenous differential equation dy/dx = (x +2y -3)/(2x + y -3).

(OR)

b. Solve x dy/dx + y = y^2 log x.

12. a. The rate at which one substance combines with another is supposed to be proportional to the amount of the first substance remaining. If there be 15 grams of the first substance when t = 0 second and 5 grams when t = 8 seconds. Find how much will be left when t = 5 seconds. Also find the value of t, when there is 1 gram left.

(OR)

b. Inside the earth, the force of gravity is proportional to the distance from the centre. If a hole be drilled from pole to pole and a rock is dropped in the hole, with what velocity will it reach the centre?

13. a. Find the first two derivatives at x = 1.05 for the table 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. Dividing the range into ten equal parts, find the approximate value of $\int_0^\pi \sin x\,dx$ by trapezoidal rule and Simpson's rule.

14. a. Solve the equation dy/dx = 1-y given y(0) = 0 using Modified Euler method for x = 0.1, 0.2, 0.3, 0.4.

(OR)

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

15. a. An enzyme was assayed at an initial substrate concentration of 2 ×10^{-5}M. In 6 min, half of the substrate had been used. The K_m for the substrate is 5 ×10^{-3}M. Calculate (i) k (ii) V_{max} (iii) the concentration of product produced by 15min.

(OR)

b. Derive the integrated form of the Henrie-Michaelis-Menten equation.

Z-Z-Z   END