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 order of the differential equation $\frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}=x+y$ is____.

(i) 1 (ii) 2 (iii) 3 (iv) 4

2 A Bernoulli differential equation is of the form _____

(i) $\frac{dy}{dx}+Py=y^nQ$ (ii) $\frac{d^2y}{dx^2}+Py=x^nQ$

(iii) $\frac{dy}{dx}+Py=x^nQ$ (iv) $\frac{dy}{dx}+Py^2x=y^nQ$

3 The error in Simpson's one-third rule is of the order

(i) h^2 (ii) h^4 (iii) h^3 (iv) h^0

4 In fourth order Runge Kutta method Δy = _____.

(i) $\frac{1}{6}(k_1+2k_2+2k_3+k_4)$ (ii) $\frac{1}{6}(k_1+k_2+k_3+k_4)$

(iii) $\frac{1}{6}(k_1+2k_2+k_3+2k_4)$ (iv) $\frac{1}{6}(k_1+2k_2+2k_3+2k_4)$

5 The Michaelis-Menten equation arises from the general equation for an enzymatic reaction_____

(i) $E + S \leftrightarrow ES \leftrightarrow E - P$ (ii) $E + S \leftrightarrow ES \leftrightarrow E / P$

(iii) $E - S \leftrightarrow ES \leftrightarrow E + P$ (iv) $E + S \leftrightarrow ES \leftrightarrow E + P$

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

6 a Solve $\left(x^2-4xy-2y^2\right)dx+\left(y^2-4xy-2x^2\right)dy=0.$

OR

b Solve $xy'+y=y^2\log x.$

7 a The number N of bacteria in a culture grew at a rate proportional to N. The value of N was initially 100 and increased to 332 in one hour. What was the value of N after $1\frac{1}{2}$ hours?

OR

b Solve the problem of a particle falling vertically either freely under the influence of gravity alone or with air resistance taken into account.

8 a The population of a certain town in given below. Find the rate of growth of the population in 1931, 1941, 1961 and 1971.

Year x :	1931	1941	1951	1961	1971
Population y :	40.62	60.80	79.95	103.56	132.65

OR

b Evaluate $\int_{-3}^{3} x^4 dx$ by using (i) Trapezoidal rule (ii) Simpson's rule.

Cont...

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

OR

b Obtain the values of y at x= 0.1 using Runge Kutta method of third order for the differential equation y′ = -y, given y(0)=1.

10 a Estimate k, the first-order rate constant, for an enzyme preparation with a V_{max} of 4.6 $\mu\ moles \times litre^{-1} \times \min^{-1}$ under the given experimental conditions $K_m = 2x10^{-6}M$.

OR

B Explain Lineweaver-Burk reciprocal plot.

SECTION -C (30 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 x 6 = 30)

11 a Solve $xdx + ydy - \left(\frac{xdy - ydx}{x^2 + y^2}\right) = 0.$

OR

b Solve $\frac{dx}{dy} + y\cot x = 4x\,\mathrm{cosec}\,x$, given that y = 0 when $x = \frac{1}{2}\pi.$

12 a The rate of decomposition of radium is proportional to the amount of radium present at any instant. If one half of any given amount of radium will disappear in 1600 years, find the percentage remaining at the end of 200 years.

OR

b If a bead is realized at the origin and slides down the wire which is in the form of the cycloid, show that (i) the time taken to reach the point (aπ, 2a) at the vertex is given by π√(a/g) (ii) also if at whatever point of the curve the particle starts, the time taken to reach the bottom(vertex) remains the same.

13 a Find the value of f′ (0.5) using Stirling's formula from the following data:

x:	0.35	0.40	0.45	0.50	0.55	0.60	0.65
y=f(x):	1.521	1.506	1.488	1.467	1.444	1.418	1.389

OR

b Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using (i) Trapezoidal rule (ii) Simpson's rule (iii) Weddle's rule.

14 a Using Modified Euler method, find y(0.2), y(0.1) given $\frac{dy}{dx} = x^2 + y^2, y(0) = 1.$

OR

b Using R.K. method of fourth order, find y(0.8) correct to 4 decimal places if $y' = y - x^2$, y(0.6)=1.7379.

15 a Given the reaction where $E + S \rightleftarrows ES \rightarrow E + P$,

$k_1 = 1\times10^7\,M^{-1}\sec^{-1}, k_{-1} = 1\times10^2\sec^{-1}, k_p = 3\times10^2\sec^{-1}$, Calculate

(a) K_s (b)K_m and (c)can k_p be very much greater than k_1?

OR

B An enzyme was assayed at an initial substrate concentration of 10^{-5} M. The K_m for the substrate is $2x10^{-9}$ M. At the end of 1 min, 2% of the substrate had been converted to product. (a) What percent of the substrate will be converted to product at the end of 3 min? What will be the product and substrate concentrations after 3 min? (b) If the initial concentration of substrate were 10^{-6}M. what percent of the substrate will be converted to product after 3 min? (c) What is the maximum attainable velocity Vmax with the enzyme concentration used? (d) At about what substrate concentration will Vmax be observed? (e) At this S concentration, what percent of the substrate will be converted to product in 3 min?

Z-Z-Z END