

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 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 $\frac{\delta M}{\delta y} = \frac{\delta N}{\delta x}$ is the criterion for $Mdx + Ndy = 0$ to be _____
 (i) exact (ii) calculus
 (iii) litre (iv) growth
- 2 When $Mx - Ny \neq 0$, and the equation is of the form
 $f_1(xy)y dx + f_2(xy)x dy = 0$, then $\frac{1}{Mx - Ny}$ is _____
 (i) Taylor factor (ii) integrating factor
 (iii) harmonic factor (iv) hyperbola
- 3 When a molecule has a tendency to decompose naturally into smaller molecules at a rate not depending on the presence of other substances, then the number of molecules of this kind decomposing in a unit time will be proportional to the total number present. A chemical reaction of this type is called _____ reaction.
 (i) half-order (ii) memory order
 (iii) radius order (iv) first order
- 4 _____ law the algebraic sum of the electromotive forces round a closed circuit is zero
 (i) Kirchhoff (ii) Euler
 (iii) Fermat (iv) Geodesic
- 5 In simpsons's one-third rule, $y(x)$ is a polynomial of degree two. To apply this rule, n , the number of intervals must be
 (i) even (ii) odd
 (iii) ∞ (iv) Euler
- 6 $\int_{x_0}^{x_n} f(x)dx = \frac{h}{2} [(y_0 + y_n) + 2(y_1 + y_2 + \dots + y_{n-1})]$ is known as
 (i) Taylor rule (ii) Trapezoidal rule
 (iii) Triangle rule (iv) Simpson's $\frac{1}{3}$
- 7 $y_{n+1} = y_n + \frac{1}{2} h [f(x_n, y_n) + f(x_n + h, y_n + hf(x_n, y_n))]$ is called
 (i) Taylor rule (ii) Eigen value
 (iii) Improved Eulers method (iv) R-K method

Cont...

- 8 Runge-Kutta method of second order is the method
 (i) Eulers method (ii) Taylor's method
 (iii) Modified Eulers method (iv) Lagranges method
- 9 Enzyme kinetics is the branch of
 (i) Enzymology (ii) Polynomial
 (iii) Mechanism (iv) Mathematica
- 10 The relationship between K_{eq} , K_m and V_{max} is known as
 (i) Bernoulli equation (ii) Haldane equation
 (iii) Hilbert equation (iv) Fermat equation

SECTION - B (25 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 x 5 = 25)

11 a Solve $(2x - 4y + 3) \frac{dy}{dx} + (x - 2y + 1) = 0$

OR

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

- 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

- 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 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 $\int \frac{1}{0.1 + x^2} dx$ using Trapezoidal rule with $h = 0.2$

- 14 a Compute y at $x = 0.25$ by modified Euler method given $y' = 2xy$, $y(0) = 1$.

OR

- b Given $y' = -y$ and $y(0) = 1$, determine the values of y at $x = (0.01) (0.02) (0.04)$ by Euler method.

- 15 a What fraction of V_{max} is observed at $[S] = 4K_m$, $[S] = 5K_m$, $[S] = 6K_m$, $[S] = 9K_m$, $[S] = 10K_m$?

OR

- b The equilibrium constant for the reaction $S \rightleftharpoons P$ is 5. Suppose we have a mixture of $[S] = 2 \times 10^{-4} M$ and $[P] = 3 \times 10^{-4} M$. $k_{ms} = 3 \times 10^{-5} M$. $V_{maxf} = 2 \mu \text{ moles} \times \text{litre}^{-1} \times \text{min}^{-1}$, $V_{max} = 4 \mu \text{ moles} \times \text{litre}^{-1} \times \text{min}^{-1}$. In which direction will the reaction proceed on addition of an appropriate enzyme?

Cont...

SECTION -C (40 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 x 8 = 40)

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

OR

b Solve $\frac{dy}{dx} - y \tan x = \frac{\sin x \cos^2 x}{y^2}$

- 17 a 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 (a) vertical and (b) horizontal.

OR

- b 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?

- 18 a Find the first and second derivative of the functions tabulated below at
- $x=3$
- using Newton forward formula.

x:	3.0	3.2	3.4	3.6	3.8	4.0
f(x):	-14	-10.032	-5.296	-0.256	6.672	14

OR

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

- 19 a Apply the fourth order Runge-Kutta method to find
- $y(0.2)$
- given that
- $y' = x + y, y(0) = 1$
- .

OR

- b Obtain the values of
- y
- at
- $x=0.1, 0.2$
- using R.K. method of second order for the differential equation
- $y' = -y$
- , given
- $y(0)=1$
- .

- 20 a Derive the Henrie-Michaelis-Menton equation for simple unireactant system with rapid equilibrium.

OR

- b Derive the relation for reversible reactions with effect of product on forward velocity.

Z-Z-Z

END