

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2026
(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 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	What is the solution to the differential equation $y' + y = 0$? (i) $y = e^x$ (ii) $y = e^{-x}$ (iii) $y = x$ (iv) $y = -x$	K1	CO1
	2	For what value of 'k', the differential equation $(x^2 + kxy)dx + (y^2 - x^2)dy = 0$ is exact? (i) 1 (ii) -1 (iii) 2 (iv) -2	K1	CO1
2	3	A population grows according to the model $dP/dt = kP$, where P is the population size, t is time, and k is a constant. If the initial population is P_0 , what is the population size at time t? (i) $P(t) = P_0 e^{kt}$ (ii) $P(t) = P_0 + kt$ (iii) $P(t) = P_0 e^{-kt}$ (iv) $P(t) = P_0 kt$	K2	CO2
	4	A tautochrone curve, where the time of descent is independent of the starting point, is a ----- (i) Parabola (ii) Circle (iii) cycloid (iv) Hyperbola	K1	CO2
3	5	How is the forward difference operator defined? (i) $\Delta f(x) = f(x+h)-f(x)$ (ii) $\Delta f(x) = f(x)-f(x-h)$ (iii) $\Delta f(x) = f(x*h)$ (iv) $\Delta f(x) = f(x+h)$	K1	CO3
	6	Using trapezoidal rule with $h=0.5$, $\int_0^1 \frac{dx}{1+x}$ provides the value (i) 0.708 (ii) 0.608 (iii) 0.508 (iv) 0.808	K1	CO3
4	7	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) all the above	K1	CO4
	8	Which of the following methods corresponds to the second-order Runge-Kutta method? (i) Modified Euler's method (ii) Euler's method (iii) Taylor's method (iv) Lagranges method	K1	CO4
5	9	Enzyme Kinetics is the branch of (i) Enzymology (ii) Polynomial (iii) Mechanism (iv) Mathematica	K1	CO5
	10	The Michaelis-Menten constant K_m is defined as (i) The substrate concentration at V_{max} (ii) The maximum velocity of the reaction (iii) The substrate concentration at $\frac{1}{2}V_{max}$ (iv) The affinity constant for the product	K1	CO5

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Solve $(2x-4y+3)\frac{dy}{dx} + (x-2y+1)=0$	K2	CO1

Cont...

	11.b.	Solve $\frac{dy}{dx} + y \cos x = \frac{\sin 2x}{2}$																	
2	12.a.	The number of bacteria in a certain culture grows at a rate proportional to the number present. If the population doubles in 5 hours, by what ratio will it increase in 25 hours?					K2	CO2											
	(OR)																		
	12.b.	A tank contains 100 litres of fresh water. 2 liters 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.																	
3	13.a.	Find the first and second derivative of the function tabulated below at x=0.4					K2	CO3											
	<table><tr><td>x</td><td>0.4</td><td>0.5</td><td>0.6</td><td>0.7</td><td>0.8</td></tr><tr><td>y</td><td>1.5836</td><td>1.7974</td><td>2.0442</td><td>2.3275</td><td>2.6511</td></tr></table>					x			0.4	0.5	0.6	0.7	0.8	y	1.5836	1.7974	2.0442	2.3275	2.6511
	x	0.4	0.5	0.6	0.7	0.8													
y	1.5836	1.7974	2.0442	2.3275	2.6511														
(OR)																			
	13.b.	By dividing the range into ten equal parts, evaluate $\int_0^\pi \sin x \, dx$ by Simpon's rule.																	
4	14.a.	Given $y' = -y$ and $y(0)=1$, determine the values of y at $x=0.02,0.04$ by Eulers method.					K2	CO4											
	(OR)																		
	14.b.	Obtain the values of y at $x=0.1,0.2$ using R.K method of second order and third order for $\frac{dy}{dx} = -y$ given $y(0)=1$.																	
5	15.a.	Estimate k, the first order rate constant, for an enzyme preparation with a V_{max} of 4.6μ Moles $\times$ liter ⁻¹ $\times$ min ⁻¹ under given experimental conditions $K_m=2 \times 10^{-6}$ M					K3	CO5											
	(OR)																		
	15.b.	For the reversible reaction $S \rightleftharpoons P$, the equilibrium constant is 5. The maximum velocity for the forward reaction is 2 micromoles per litre per minute while the maximum velocity for the reverse reaction is 4μ . Calculate the initial velocity of the reaction if the starting concentrations are 2×10^{-4} M for substrate S and 3×10^{-4} M for product P and $K_{ms}=3 \times 10^{-5}$ M. What is the initial velocity v_0 ?																	

SECTION -C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Solve $(1+xy^2)dx + (1+x^2y)dy=0$.	K2	CO1
2	17	Derive the Tautochronous property of the cycloid.	K3	CO2
3	18	Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule with $h=0.2$. Hence determine the value of π .	K2	CO3
4	19	Using Runge Kutta method of fourth order find $y(0.1)$, given $\frac{dy}{dx} = x^2 - y$, $y(0)=1$.	K2	CO4
5	20	Examine the methods of plotting enzyme kinetics data.	K4	CO5

Z-Z-Z

END