

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION MAY 2026
(Second Semester)

Branch - MATHEMATICS

DIFFERENTIAL EQUATION & LAPLACE TRANSFORMS

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	A function that satisfies a differential equation when substituted into it is called: (i) Operator (ii) Solution (iii) Model (iv) Variable	K1	CO1
	2	The equation $\frac{dP}{dt} = KP$ models: (i) Logistic growth (ii) Exponential growth (iii) Linear decay (iv) Oscillations	K2	CO1
2	3	W(cos x, sin x) is (i) 0 (ii) -1 (iii) 1 (iv) 2	K1	CO2
	4	The integrating factor of $y' + 2y = x$ is (i) e^{2x} (ii) e^{-x} (iii) x^2 (iv) $2x$	K2	CO2
3	5	The equation $y'' + y = \sin x$ is (i) Homogeneous Equation (ii) Nonlinear Equation (iii) Nonhomogeneous Linear Equation (iv) Algebraic Equation	K1	CO3
	6	Complementary function of $y'' - 3y' + 2y = e^{2x}$ is (i) $C_1 e^x + C_2 e^{2x}$ (ii) $C_1 e^0 + C_2 x e^x$ (iii) $C_1 e^{0x} + C_2 x e^{2x}$ (iv) $C_1 e^x - e^{2x}$	K2	CO3
4	7	Linear Differential equations are transformed into _____ equations (i) integral (ii) nonlinear (iii) algebraic (iv) linear	K1	CO4
	8	Laplace transform of $\sin(at)u(t)$ is? (i) $\frac{s}{a^2 + s^2}$ (ii) $\frac{sa}{a^2 + s^2}$ (iii) $\frac{a}{a^2 + s^2}$ (iv) $\frac{s^2}{a^2 + s^2}$		
5	9	$L\{te^{at}\} =$ (i) $\frac{1}{s-a}$ (ii) $\frac{1}{(s-a)^2}$ (iii) $\frac{1}{(s-a)^3}$		
	10	A Laplace Transform exists when (i) The function is piece-wise continuous (ii) The function is of exponential order (iii) The function is piecewise differentiable (iv) The function is of differential order		

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.	A lunar lander is falling freely toward the surface of the moon at a speed of 450 meters per second. Its retrorockets, when fired, provide a constant deceleration of 2.5 meter per second (the gravitational acceleration produced by the moon is assumed to be included in the given deceleration). Classify, At what height above the lunar surface should the retrorockets be activated to ensure a soft touchdown ($v=0$ at impact)?	K2	CO1
		(OR)		
	11.b.	Solve the differential Equation $\frac{dy}{dx} = (x + y + 3)^2$		
2	12.a.	Solve the initial value problem $y'' + 2y' + y = 0$; with initial conditions $y(0) = 5, y'(0) = -3$.	K3	CO2
		(OR)		
	12.b.	Construct the Particular solution of $y'' + 3y' + 4y = 3x + 2$;		
3	13.a.	Build a general solution of the system $(D - 4)x + 3y = 0, -6x + (D + 7)y = 0$	K3	CO3
		(OR)		
	13.b.	Solve the two-dimensional system $x' = -2y, y' = \frac{1}{2}x$		
4	14.a.	Demonstrate of $L\{t^a\}$.	K2	CO4
		(OR)		
	14.b.	Illustrate $L\{t \sin kt\}$.		
5	15.a.	Demonstrate $L\{\frac{\sin ht}{t}\}$.	K3	CO5
		(OR)		
	15.b.	Find convolution of $\sin 2t$ and e^t		

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	Construct the general solution of $(x^2 + 1)\frac{dy}{dx} + 3xy = 6x$	K3	CO1
2	17	Examine the initial value problem $y'' - 3y' + 2y = 3e^{-x} - 10\cos 3x$; with initial conditions $y(0) = 1, y'(0) = 2$.	K4	CO2
	18	Analyze the particular solution for the system $x' = 4x - 3y, y' = 6x - 7y$ that satisfies the initial conditions $x(0) = 2, y(0) = -1$	K4	CO3
	19	Solve the initial value problem $x'' + 4x = \sin 3t; x(0) = x'(0) = 0$.	K3	CO4
		A mass $m = 1$ is attached to a spring with constant $k = 4$; there is no dashpot. The mass is released from rest with $x(0) = 3$. At the instant $t = 2\pi$ the mass is struck with a hammer, providing an impulse $p = 8$. Analyse and find the motion of the mass.	K4	CO5