

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2026

(CBCSS - UG)

(Regular/Supplementary/Improvement)

CC19UMTS6B13 / CC20UMTS6B13 - DIFFERENTIAL EQUATIONS

(Mathematics - Core Course)

(2019 Admission onwards)

Time : 2.5 Hours

Maximum : 80 Marks

Credit : 4

Part A (Short answer questions)Answer *all* questions. Each question carries 2 marks.

1. Solve the initial value problem $\frac{dy}{dt} = -y + 5$, $y(0) = 0$.
2. Verify that $\cosh t$ is a solution of the differential equation $y'' - y = 0$.
3. Solve the equation $\frac{dy}{dx} = \frac{x^2}{1 - y^2}$.
4. Find an interval in which the initial value problem $ty' + 2y = 4t^2$; $y(1) = 2$ has a unique solution.
5. Define integrating factor.
6. Find the general solution of $16y'' + 24y' + 9y = 0$.
7. Write the general form of particular solution if right side of the given differential equation $g(t) = \sin at$.
8. Solve the boundary value problem $y'' + y = 0$ $y(0) = 1$ $y(\pi) = 2$.
9. Write the formula for finding the particular solution of the differential equation by using the method of variation of parameters.
10. What is the radius of convergence of the Taylor series for $(1 + x^2)^{-1}$ about $x = 0$.
11. Find the Laplace transform of $\cos at$.
12. Find the inverse Laplace transform of $\frac{b}{(s - a)^2 + b^2}$.
13. Write the expression for $\mathcal{L}(f'(t))$ and $\mathcal{L}(f''(t))$.
14. Find the fundamental period of $\cos(2\pi x)$.
15. Prove that the product of two even functions are even.

(Ceiling: 25 Marks)

Part B (Paragraph questions)

Answer **all** questions. Each question carries 5 marks.

16. Determine whether the equation $(3x^2 - 2xy + 2) + (6y^2 - x^2 + 3)y' = 0$ is exact. If it is exact, find the solution.
17. Find the solution of the initial value problem $4y'' - y = 0$, $y(-2) = 1$, $y'(-2) = -1$.
18. Show that $y_1(t) = \cos(2t)$ and $y_2(t) = \sin(2t)$ form a fundamental set of solution of $y'' + 4y = 0$.
19. Find the solution of the initial value problem $y'' + 4y = 0$, $y(0) = 0$, $y'(0) = 1$.
20. Find the Laplace transform of $f(t) = \int_0^t \sin(t - \tau) \cos(\tau) d\tau$.
21. Using convolution theorem, find the inverse Laplace transform of $\frac{1}{(s + 1)^2(s^2 + 4)}$.
22. Solve the boundary value problem $y'' + y = 0$; $y(0) = 1$, $y(\pi) = a$.
23. Find the Fourier series of $f(x) = x$, $-1 \leq x < 1$; $f(x + 2) = f(x)$.

(Ceiling: 35 Marks)

Part C (Essay questions)

Answer any **two** questions. Each question carries 10 marks.

24. Solve the initial value problem $y' + \frac{2}{t} y = \frac{\cos t}{t^2}$ $y(\pi) = 0$ $t > 0$.
25. Find the general solution of $y'' + 4y = t^2 + 3e^t$, $y(0) = 0$, $y'(0) = 2$.
26. Find the solution of the initial value problem $y'' + 2y' + 2y = \delta(t - 5)$ $y(0) = 0$, $y'(0) = 0$.
27. Find the temperature $u(x, t)$ at any time in a metal rod 40cm long, insulated on the sides, which initially has a uniform temperature of $30^\circ C$ throughout and whose ends are maintained at $0^\circ C$ for all $t > 0$.

(2 × 10 = 20 Marks)
