



**B.Sc. V Semester (CBCS) Degree Examination, March/April - 2022**  
**MATHEMATICS - IX**

**Paper No. 5.1 - Integral Transforms**

Time : 3 Hours

Maximum Marks : 70

**Instruction :** Answer all the Sections.

**SECTION - A**

Answer **any five** of the following :**5x2=10**

1. Find  $L[\sinh mt]$
2. Find  $L[\cos^2 t]$
- 3'. Find  $L[e^{-2t} \cosh 4t]$
4. Using Convolution theorem find  $L^{-1}\left[\frac{1}{(s+1)(s+2)}\right]$
5. If  $f(x) = \begin{cases} -x & ; -\pi < x < 0 \\ x & ; 0 < x < \pi \end{cases}$  find Fourier coefficient of  $b_n$ .
6. If  $f(s)$  is Fourier transform of  $F(x)$ , then prove that  $\frac{1}{a} f\left(\frac{s}{a}\right)$  is the Fourier transform of  $F(ax)$  i.e.  $F(ax) = \frac{1}{a} f\left(\frac{s}{a}\right)$
7. Find Z-transform of  $a^n \cdot n$   
i.e.  $Z[a^n \cdot n]$ .

**P.T.O.**

**SECTION - B**

**Answer any five questions :**

**5x6=30**

8. If  $L[f(t)] = F(s)$  then prove that  $L[t^n f(t)] = (-1)^n \frac{d^n}{ds^n} [F(s)]$

9. Find the Laplace transform of  $\frac{e^{-mt} - e^{-nt}}{t} \leftrightarrow \left( \frac{\sin m}{s-1} \right)$

10. Find the Inverse Laplace transform of  $\frac{3s^2 + 16s + 26}{s(s^2 + 4s + 13)}$

11. Solve the simultaneous differential equation  $\frac{dx}{dt} + y = \sin t; \frac{dy}{dt} + x = \cos t$  with  $x(0) = 2, y(0) = 0$ .

12. Obtain the Fourier series of  $f(x) = \begin{cases} -k & ; (-\pi, 0) \\ k & ; (0, \pi) \end{cases}$  and

hence deduce that  $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$

13. Find the half range sine series of function  $f(x) = x(\pi - x)$  in interval  $0 < x < \pi$ .

14. Find the complex form of Fourier series for the function  $f(x) = x$  in  $(-\pi, \pi)$ .

**SECTION - C**

**Answer any five of the following :**

**5x6=30**

15. Find the Fourier transform of  $f(x) = \begin{cases} 1 & ; |x| \leq 1 \\ 0 & ; |x| > 1 \end{cases}$  and hence evaluate  $\int_0^\infty \frac{\sin x}{x} dx$ .

16. Find the Fourier sine and cosine transform of  $7e^{-6x} + 8e^{-9x}$

17. Using Parseval's identify for Fourier cosine transform show that

$$\int_0^{\infty} \frac{\sin ax}{x(a^2 + x^2)} dx = \frac{\pi(1 - e^{-a^2})}{2a^2} \text{ where } a > 0$$

18. Find the Fourier Integral of function  $f(x) = \begin{cases} 0 & ; x < 0 \\ \frac{1}{2} & ; x = 0 \text{ and hence} \\ e^{-x} & ; x > 0 \end{cases}$

show that  $f(0) = \frac{1}{2}$ .

19. Find the Z-transform of  $\sin(3n + 5)$ .

20. Compute the inverse-Z-transform of  $\frac{3z^2}{(5z - 1)} + \frac{2z}{(5z + 2)}$ .

21. Solve differential  $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$  with  $y_0 = y_1 = 0$  using Z-transform.

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