

5. Write down the appropriate solution of the one dimensional heat flow equation.
How is it chosen?
6. The ends A and B of a rod 30 cm long, have their temperature kept at 10°C and 100°C respectively. Then obtain the steady state temperature.
7. What are the sufficient conditions for the existence of Fourier transform of a function $f(x)$?
8. Obtain the Fourier cosine transform of $\frac{1}{2^t}$.
9. Find the inverse Z transform of $\frac{z}{(z-1)^2}$.
10. State final value theorem in Z transform.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Solve : $(x - 2z)p + (2z - y)q = y - x$. (8)
 - (ii) Solve : $(D^3 + D^2D' - 4DD'^2 - 4D'^3)z = \cos(2x + y)$. (8)
- Or
- (b) (i) Solve the PDE $2z + p^2 + qy + 2y^2 = 0$. (8)
 - (ii) Solve $(D^2 + 2DD' + D'^2 - 2D - 2D')z = \sin(x + 2y)$. (8)
12. (a) (i) Obtain the Fourier series of periodicity 2π for $f(x) = e^x$ in the interval $0 < x < 2\pi$. (8)
 - (ii) Obtain the half range Fourier cosine series of $f(x) = x(l - x)$ in $(0, l)$. (8)

Or

- (b) The following table gives the variations of periodic current over a period.

t sec :	0	T/6	T/3	T/2	2T/3	5T/6	T
A amp :	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic. (Harmonic Analysis). (16)

13. (a) A tightly stretched string of length $2l$ is fastened at both ends. The midpoint of the string is displaced by a distance ' b ' transversely and the string is released from rest in this position. Find the displacement y at any distance x from one end at any time t . (16)

Or

- (b) An infinitely long metal plate in the form of an area is enclosed between the lines $y = 0$ and $y = \pi$ for positive values of x . The temperature is zero along the edges $y = 0$ and $y = \pi$ and the edge at infinity. If the edge $x = 0$ is kept at temperature ' ky ', find the steady state temperature at any point in the plate. (16)

14. (a) (i) Find the Fourier transform of $f(x)$ given by $f(x) = \begin{cases} 1, & \text{for } |x| \leq a \\ 0, & \text{for } |x| > a \end{cases}$. (8)
- (ii) Find the Fourier sine transform of $f(x) = e^{-ax}$, $a > 0$ and hence find $F_C(xe^{-ax})$. (8)

Or

- (b) (i) Using Parseval's identity for Fourier transforms, evaluate $\int_0^{\infty} \frac{ds}{(a^2 + s^2)(b^2 + s^2)}$. (8)

- (ii) Find the Fourier cosine transform of $f(x) = \begin{cases} x & ; 0 < x < 1 \\ 2 - x & ; 1 < x < 2 \\ 0 & ; x > 2 \end{cases}$. (8)

15. (a) Using Z transform, solve the difference equation $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$ with $u_0 = 0$, $u_1 = 1$. (16)

Or

- (b) State and prove convolution theorem in Z transforms and use it to find $Z^{-1} \left\{ \frac{z^2}{(z-a)(z-b)} \right\}$. (16)