Bapuji Educational Association (Regd.)

BAPUJI INSTITUTE OF ENGINEERING AND TECHNOLOGY, DAVANAGERE-04

DEPARTMENT OF MATHEMATICS

Transform Calculus, Fourier Series and Numerical Techniques (18MAT31)

Assignment -I

1) Find the Laplace transform of $i)\ \left(\frac{\sin 2t}{\sqrt{t}}\right)^2$ $ii)\ \left(\frac{4t+5}{e^{2t}}\right)^2$

2) Find $L[f(t)]$ of triangular wave of period 2a given by $f(t)=\begin{cases} t & 0<t<a \\ 2a-t & a<t<2a \end{cases}$

3) Find the Laplace transform of periodic function of period $\frac{2\pi}{\omega}$, $f(t)=\begin{cases} \sin\omega t, & 0<t<\pi/\omega \\ 0, & \pi/\omega<t<2\pi/\omega \end{cases}$

4) If $f(t)=\begin{cases} t & 0<t<a \\ 2a-t & a<t<2a \end{cases}$ show that $L[f(t)]=\frac{1}{s^2}\tanh\left[\frac{as}{2}\right]$

5) Express f(t) in terms of unit step function and hence find $L[f(t)]$ where $f(t)=\begin{cases} 1 & 0\le t\le 1 \\ t & 1<t<2 \\ t^2 & t>2 \end{cases}$

6) Find $i)\ L^{-1}\left\{\frac{2s-1}{s^2+4s+29}\right\}$ $ii)\ L^{-1}\left\{\log\left(\frac{s+a}{s+b}\right)\right\}$

$iii)\ L^{-1}\left\{\frac{2s^2-6s+5}{s^3-6s^2+11s-6}\right\}$ $iv)\ L^{-1}\left\{\frac{1}{s+2}+\frac{3}{2s+5}-\frac{4}{3s-2}\right\}$

7) Find f(t) from the equation $f(t)=1+2\int_0^t f(t-u)e^{-2u}du$.

8) State Convolution theorem and evaluate $L^{-1}\left\{\frac{1}{\left(s^2+a^2\right)^2}\right\}$

9) Find the inverse Laplace transform of $\frac{1}{s(s^2+1)}$ using convolution theorem

10) Solve the differential equation by Laplace Transform method $y^{11}+4y^1+3y=e^{-t}$ given $y(0)=y^1(0)=1$

11) Obtain the Fourier series expansion of $f(x)=x-x^2\ in\ (-\pi,\pi)$ and Hence deduce that $\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}\cdots$

12) Expand $f(x) = |x|$ as Fourier series in $-\pi < x < \pi$ and deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} - \cdots$

13) Find the half range sine series of e^x in the interval $0 \le x \le 1$.

14) Find the half range cosine series of $f(x) = (x-1)^2$ in the interval $0 \le x \le 1$

15) Compute the first two harmonics of the Fourier Series of f(x) given the following table:

x^0	0	60^0	120^0	180^0	240^0	300^0
y	7.9	7.2	3.6	0.5	0.9	6.8

16) Obtain the Fourier series upto first harmonic given:

x	0	1	2	3	4	5	6
y	9	18	24	28	26	20	9

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Assignment -II

1) Find the complex Fourier transform of the function

$$f(x) = \begin{cases} 1 & for \quad |x| \leq a \\ 0 & for \quad |x| > a \end{cases} \quad , \text{ Hence evaluate } \int_0^\infty \frac{sinx}{x}\, dx$$

2) Find the Fourier Sine transform of $f(x) = e^{-|x|}$ and Hence evaluate $\int_0^\infty \frac{xsinmx}{1+x^2}\, dx$ m>0

3) Find the infinite Fourier transform of $e^{-|x|}$

4) Find the inverse Z-transform of $\frac{4z^2-2z}{z^3-5z^2+8z-4}$

5) Solve: $u_{n+2} - 3u_{n+1} + 2u_n = 3^n$, given $u_0 = u_n = 0$.

6) Solve: $\frac{dy}{dx} = e^x - y,\ y(0) = 2$ using Taylor's Series method upto 4th degree terms and find the value of y(1.1).

7) Use Runge –Kutta method of fourth order to solve $\frac{dy}{dx} + y = 2x \ at \ x = 1.1 \ given \ y(1) = 3 (Take \ h = 0.1)$

8) Apply Milne's predictor-corrector formulae to compute y(0.4)given $\frac{dy}{dx} = 2e^x y$, with

x	0	0.1	0.2	0.3
y	2.4	2.473	3.129	4.059

9) Using Adams-Bashforth method, find $y(4.4)$ given $5x\frac{dy}{dx} + y^2 = 2$ with

x	4	4.1	4.2	4.3
y	1	1.0049	1.0097	1.0143

10) Solve by Runge Kutta method $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for x=0.2 correct 4 decimal places using initial conditions y(0)=1,$y'(0) = 0, h = 0.2$.

11) Apply Milne's predictor-corrector method to compute $\frac{d^2y}{dx^2} = 1 + \frac{dy}{dx}$ and the following table of initial values:

X	0	0.1	0.2	0.3
Y	1	1.1103	1.2427	1.3990
y'	1	1.2103	1.4427	1.6990

12) Derive Euler's equation in the standard form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left[\frac{\partial f}{\partial y'}\right] = 0$

13) Find the extremal of the of the functional $\int_0^{\frac{\pi}{2}} [y^2 - (y')^2 + 2ysinx]\, dx; y\left(\frac{\pi}{2}\right) = 1$, y(0)=0.

14) Prove that geodesics of a plane surface are straight lines.

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