Solve the following homogeneous linear differential equations with constant coefficients

1. $y'' - 3y' + 2y = 0$.

Solve the following differential equations using Undetermined coefficient method

1. $(D^2 - 6D + 7)y = e^{2x}$.

Solve the following differential equation by variation of parameter

1. $(D^2 + 1)y = \sec x$.
2. $(D^2 + 4D + 4)y = x^2 e^x$.

Solve the following non-homogeneous Cauchy-Euler differential equations.

1. $x^2 y'' - 4xy' + 6y = 21x^{-4}$.

In an LCR circuit with equation $L\frac{a\text{-}q}{dt^2} + R\frac{aq}{dt} + \frac{q}{c} = E(t)$, $R = 40ohms$,$L = 10henries$, And $C = \frac{1}{80}farad$, Applied voltage $E(t) = 10\ sint$ and $q(0) = 1, q'(0) = 0$. Then find charge on capacitor.

Find the Laplace Transforms of the following functions:

$\cos^2 3t$

$e^{2t}(cos2t + sin4t)$

$\frac{sin3tcos2t}{t}$

Find the inverse Laplace transform of following:

$\frac{3s-2}{(s^2+3s+2)}$

$\frac{s+2}{s^2-4s+13}$

$\log\left(\frac{s+a}{s+b}\right)$

(i) Find the Laplace Transform of the following Piecewise continuous functions

$$f(t) = \begin{cases} t & 0 \le t < 1 \\ 2-t & 1 \le t < 2 \\ 0 & t \ge 2 \end{cases}$$

Evaluate the following using second shifting theorem:

(a) $L(e^{4t}u(t-3))$ (b) $L(sint\ u(t-1))$

Solve the following IVP using Laplace transform:

1. $\frac{d^2y}{dt^2} - 6\frac{dy}{dt} + 9y = t^2e^{3t}, y(0) = 2, y'(0) = 6.$

Evaluate $\int_{-1}^{1}\int_{0}^{2}(1-6x^2y)\,dx\,dy$

Exercise: Evaluate $I = \iint_R (6x + 2y^2)\,dA$, where R is the region enclosed by the parabola $x = y^2$ and the line $x + y = 2$.

Example: Evaluate $\iint \frac{4xy}{x^2+y^2} e^{-x^2-y^2}\, dx\, dy$ over the region bounded by the circle $x^2 + y^2 - x = 0$ in the first quadrant.

Exercise: $\int_1^2 \int_2^3 \int_0^1 xyz\,dx\,dy\,dz$

Verify Green's theorem for $\oint_C (x - y)dx + 3xy\, dy$, where C is the boundary of the region bounded by the parabolas $x^2 = 4y$ and $y^2 = 4x$

Find the work done in moving a particle in the force field

$\bar{F} = (3x^2)i + (2xz - y)j + zk$ along the curve $x^2 = 4y$ and $3x^3 = 8z$ from x=0 to x=2 .

Find a unit normal vector to the surface $x^2 + y^2 + z^2 = a^2$ at the point $\left(\frac{a}{\sqrt{3}}, \frac{a}{\sqrt{3}}, \frac{a}{\sqrt{3}}\right)$

Find the directional derivative of $\emptyset\,(x, y, z) = xy^2 + yz^2$ at $(2, -1,1)$ in the direction of the vector $i + 2j + 2k$

Find $curl\ curl\ \underline{A}$, where $\underline{A} = x^2yi - 2xzj + 2yzk$ at the point $(1,0,2)$

$x^2(x + 1)y'' + (x^2 - 1)y' + 2y = 0$ at points x=0 and x =1

Solve the following equation in power series.

$y'' + y = 0$

Find the Fourier integral for $f(x) = \frac{\pi}{2} sinx, \quad 0 < x < \pi$
$= 0, \quad x > \pi$

Find Fourier sine integral representation of

$$f(x) = \begin{cases} cosx & ,0 < x < \pi/2 \\ 0 & ,x > \pi/2 \end{cases}$$