R V COLLEGE OF ENGINEERING

(An autonomous institution affiliated to VTU, Belgaum)

DEPARTMENT OF MATHEMATICS

FUNDAMENTALS OF LINEAR ALGEBRA, CALCULUS & DIFFERENTIAL EQUATIONS (MAT211BT)

UNIT-V

LINEAR ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

TUTORIAL SHEET-1

1. Solve the following differential equations.

$(i)\ 2y'' - 5y' - 3y = 0$ $\qquad (ii)\ (D^2 - 10D + 25)y = 0$

$(iii)\ \dfrac{d^2y}{dx^2} + 4\dfrac{dy}{dx} + 7y = 0$ $\qquad (iv)\ y''' + 3y'' - 4y = 0$

$(v)\ \dfrac{d^4y}{dx^4} + 2\dfrac{d^2y}{dx^2} + y = 0$ $\qquad (vi)\ 3y''' + 5y'' + 10y' - 4y = 0$

$(vii)\ \dfrac{d^3u}{dt^3} + \dfrac{d^2u}{dt^2} - 2u = 0$ $\qquad (viii)\ y'' + 16y = 0, y(0) = 2, y'(0) = -2$

$(ix)\ y'' - 2y' + y = 0, y(0) = 0, y(1) = 3$

$(x)\ y'' + y = 0, y'(0) = 0, y'(\frac{\pi}{2}) = 0$

$(xi)\ y'' + 2ky' + (k^2 + w^2)y = 0, y(0) = 1, y'(0) = -k$

$(xii)\ y''' - 4y' = 0, y'(0) = y(0) = y''(0).0 = 1$

2. The roots of the cubic auxiliary equation are $m_1 = 4$, $m_2 = m_3 = -5$, what is the corresponding homogeneous linear differential equation?

3. Show that the solution of the differential equation

$\dfrac{d^2y}{dx^2} - 4\dfrac{dy}{dx} - 4y = 0$ is $y = e^{-2x}[c_1 \cosh\sqrt{2}x + c_2 \sinh\sqrt{2}x]$.

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TUTORIAL SHEET-2

1. Find the solution of the following differential equations:

$(i)\ \frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = \cosh x$

$(ii)\ \frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = (e^{3x} + 3)^2$

2. Solve the following differential equations.

$(i)\ \frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = \cos^2 x + 2^x$

(ii) $\frac{d^2x}{dt^2} + x = \sin t \sin 2t \sin 3t$

(iii) $\frac{d^4y}{dx^4} - y = \cosh(x-1) + \sin x$

(iv) $\frac{d^3y}{dx^3} + y = 65\cos(2x+1) + e^x$

(v) $(2D^2 + 2D + 3)y = x^2 + 2x - 1$

(vi) $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = e^{2x} + x^3$

(vii) $y'' - y = x, y(0) = 0, y(1) = 0$

(viii) $\frac{d^2y}{dx^2} + 4y = \sin 2x, y(0) = 1, y(1/2) = 0$

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LINEAR ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

TUTORIAL SHEET-3

1. Solve the following differential equations:

(i) $\frac{d^2y}{dt^2}+4y=t^2e^{3t}$

(ii) $\frac{d^3y}{dx^3}-7\frac{dy}{dx}+6y=e^{2x}(1+x)$

(iii) $\frac{d^2y}{dx^2}+4y=2e^x\sin^2 x$

(iv) $\frac{d^2x}{dt^2}-4x=t^2\cos t$

(v) $\frac{d^2u}{dx^2}-4u=x\sinh x$

(vi) $\frac{d^2y}{dx^2}-y=xe^x\sin x$

2. Find the solution of the following differential equations:

(i) $2x\frac{d^2y}{dx^2}+3\frac{dy}{dx}-\frac{y}{x}=5-\frac{\sin\log x}{x}$

(ii) $x^3\frac{d^3y}{dx^3}+2x^2\frac{d^2y}{dx^2}+2y=10\left[x+\frac{1}{x}\right]$

(iii) $(5+2x)^2\frac{d^2y}{dx^2}-6(5+2x)\frac{dy}{dx}+8y=6x$

(iv) $x^2\frac{d^2y}{dx^2}-2y+x=0, y(2)=y(3)=0.$

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TUTORIAL SHEET-4

1. Solve the following differential equations by the method of variation of parameters:

(i) $y'' + y = \dfrac{1}{1+\sin x}$

(ii) $y'' + 2y' + y = 4e^{-x}\log x$

(iii) $\dfrac{d^2y}{dx^2} - y = e^{-2x}\cos(e^{-x})$

(iv) $xy'' - y' = (3+x)x^2e^x$

2. In a simple harmonic motion, the amplitude of motion is 5 meters and the period is 4 seconds. Find the time required by the particle in passing between the points which are at distance of 4 meters and 2 meters from the centre of the force and are on same side of it. Also find the velocities at these points.

(Equation of SHM is $\dfrac{d^2x}{dt^2} = -\mu^2 x$)

3. Find the current in the RLC circuit assuming zero initial current and charge and R=160 ohm, L=20 Henry, C= 2.10^{-3} Farad and E = 48.1 sin(10t) volts.

(The differential equation for the charge Q is $L\dfrac{d^2Q}{dt^2} + R\dfrac{dQ}{dt} + \dfrac{Q}{c} = E$)

Objective Questions:

1. The order and degree of the differential equation is ___and ____.
2. The complementary function of the differential equation is , then Wronskian is _________.
3. _________.
4. Particular integral of is_________.
5. If is the solution of the equation then value of is _________.
6. Reduce the differential equation to a linear differential equation with constant coefficient