Assignment 1

PHY310: Mathematical Methods for Physicists I

Instructor:Dr. Prasenjit Das **No Need to Submit**

Solve the following differential equations:

1.

$$\frac{dy}{dx} - 2y\cot 2x = 1 - 2x\cot 2x - 2\,\mathrm{cosec}\,2x. \tag{1}$$

Ans:$y = x + \cos 2x + c\sin 2x.$ (2)

2.

$$\frac{dy}{dx} + \frac{3}{x}y = x^2. \tag{3}$$

Ans:$y = \frac{x^3}{6} + cx^{-3}.$ (4)

3.

$$\frac{dy}{dx} + x = \frac{y}{x}. \tag{5}$$

Ans:$y = -x^2 + cx.$ (6)

4.

$$\frac{dy}{dx} + y\ln x = e^{-x\ln x}. \tag{7}$$

Ans:$y = \frac{ce^x}{x^x} - \frac{1}{x^x}.$ (8)

5.

$$\frac{dy}{dx} - \frac{n}{x}y = e^x x^n. \tag{9}$$

Ans:$y = x^n(e^x + c).$ (10)

6.

$$\frac{dy}{dx} + y = e^x. \tag{11}$$

Ans:$2y = e^x + ce^{-x}.$ (12)

7.

$$x^3\frac{dy}{dx} + (2 - 3x^2)y = x^3. \tag{13}$$

Ans:$2y = x^3 + cx^3 e^{\frac{1}{x^2}}.$ (14)

8.

$$\frac{dy}{dx} - y\cot x + \operatorname{cosec} x = 0. \tag{15}$$

Ans: $y = c\sin x + \cos x.$ (16)

9.

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 5y = 0. \tag{17}$$

Ans: $y = Ae^{(-1+2i)x} + Be^{(-1-2i)x}.$ (18)

Alternative form: $y = e^{-x}(c_1\cos 2x + c_2\sin 2x).$ (19)

10.

$$\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 16y = e^{-6x}. \tag{20}$$

Ans: $y = y_c + y_p = e^{4x}(Ax + B) + 0.01e^{-6x}..$ (21)

11.

$$(D^2 + 4)y = x^2. \tag{22}$$

Ans: $y = A\cos 2x + B\sin 2x + \frac{1}{4}(x^2 - \frac{1}{2})..$ (23)

12.

$$\frac{d^4x}{dt^4} + 4x = 0. \tag{24}$$

Ans: $x = e^{-t}(c_1\cos t + c_2\sin t) + e^{t}(c_3\cos t + c_4\sin t).$ (25)

13.

$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = x^4e^{2x}. \tag{26}$$

Ans: $y = (A + Bx)e^{3x} + \frac{1}{30}x^6e^{3x}..$ (27)

14.

$$\frac{d^2y}{dx^2} - 4y = x\sinh x. \tag{28}$$

Ans: $y = Ae^{2x} + Be^{-2x} - \frac{x}{3}\sinh x - \frac{2}{9}\cosh x..$ (29)

15.

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x\sin x. \tag{30}$$

Ans: $y = (A + Bx)e^x - e^x(x\sin x + 2\cos x)..$ (31)