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MAT NO: 17/ENG04/081

DEPT: ELECT/ELECT.

1 a) Define a differential equation and give two examples.

b) An expression has been obtained for an engineering system to be given in equation

(1) $y = Ae^{-4x} + Be^{-6x}$

i) What is the order of the differential equation that can be formed from the expression?

ii) Give a reason for your answer in b(i)

iii) Form a differential equation from the expression.

Answers

1) a) A differential equation is a relationship between an independent variable (x) a dependent variable (y) and one or more derivatives of the dependent variable (y) with respect to the independent variable (x).

Some Examples of differential equations are:

i. $\frac{d^2y}{dx^2} - \frac{3dy}{dx} + 2y = x^2$ (an example of a second order differential equation)

ii. $\cos^2 x \frac{dy}{dx} + y = 1$ (an example of a first order differential equation).

b) (i) The expression $y = Ae^{-4x} + Be^{-6x}$ will form a second order differential equation.

(ii) The reason a second order differential equation will be formed is because the equation has 2 arbitrary constants ie A and B.

iii) Let the equation which $y = Ae^{-4x} + Be^{-6x}$ is formed from be

$$a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0 \quad \text{---(i)}$$

Re writing eqn (i) in the form $y = Ae^{m_1 x} + Be^{m_2 x}$

Therefore $m_1 = -4$ and $m_2 = -6$

The auxiliary equation will be $(m+4)(m+6) = 0$

$= m^2 + 10m + 24 = 0$ — (2)

Let $\frac{d^2y}{dx^2}$ be m^2 and $\frac{dy}{dx}$ be m and $y = 1$

Therefore substituting equation (1) in (2)

$\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 24y = 0$ will be the differential equation formed from the expression.