Course: Engineering Mathematics II (MTH11502) **Group**: B.Tech (All) (Semester II)
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1. Formulate differential equations corresponding to the following functions and hence find the order, degree, and nature (linear or non-linear) of the equation ($a\ and\ b$ are arbitrary constants):
   a. $y^2 = 4a(x + a)$
   b. $ax^2 + by^2 = 1$
   c. $y = ae^{3x} + be^{x}$
2. Using appropriate methodology, solve the following first order differential equations:
   a. $x\dfrac{dy}{dx} - y = 2x^2 y$
   b. $ydx + \left(-x - y^2\right)dy = 0$
   c. $\dfrac{dy}{dx} = \dfrac{y(x-y)}{x(2x+3y)}$
   d. $\left(x^2 - 1\right)\dfrac{dy}{dx} + 2xy = 2x - 2$
   e. $\dfrac{dy}{dx} = \dfrac{2x + 3y + 4}{4x + 6y + 1}$
   f. $e^x siny\ dx + (e^x + 1)cosy\ dy = 0.$
   g. $(x^2 + y^2)dx - 2xy\ dy = 0.$
   h. $ylogy\ dx + (x - logy)\ dy = 0.$
3. Find the convergence of the following series:

   i) $\frac{1}{2^2} + \frac{2^2}{3^3} + \frac{3^3}{4^4} + \cdots$

   ii) $\frac{1}{1+1} + \frac{1}{1+2} + \frac{1}{1+2^2} + \frac{1}{1+2^3} + \cdots$

   iii) $\left(\frac{1}{2}\right)^2 + \left(\frac{1.3}{2.4}\right)^2 + \left(\frac{1.3.5}{2.4.6}\right)^2 + \cdots$

   iv) $\frac{3}{5} + \frac{4}{5^2} + \frac{3}{5^3} + \frac{4}{5^4} + \cdots$

   v) $\sum \frac{(-1)^n n!}{n^n}$

   vi) $1 + \frac{2^p}{2!} + \frac{3^p}{3!} + \frac{4^p}{4!} + \cdots (p > 0)$

   vii) $\sum_{n=1}^{\infty} \sqrt[3]{n^3 + 1} - n$

   viii) $\sum_{n=2}^{\infty} \frac{1}{\sqrt{n(n-1)}}$

   ix) $\sum_{n=1}^{\infty} (\sqrt{n^4 + 1} - \sqrt{n^4 - 1})$

   x) $\sum_{n=1}^{\infty} (\frac{n^2}{2^n} + \frac{1}{n^2})$.

   Note: **Marks (2+4+5)=11**