NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi-Abuja

FACULTY OF SCIENCES
DEPARTMENT OFMATHEMATICS
2021_1 Examinations

Course Code:	**MTH302**
Course Title:	**Elementary Differential Equations II**
Credit Unit:	**3**
Time Allowed:	**3 Hours**
Total:	**70 Marks**
Instruction:	**Answer Question One (1) and Any Other 4 Questions**

1. (a)Determine whether $x = 0$ is a regular singular point of the following differential equations

   (i) $2x^2y'' + 7x(x+1)y' - 3y = 0$ **(3 marks)**

   (ii) $x^3y'' + 2x^2y' + y = 0$ **(3 marks)**

   (b)Use the power series method to find the general solution near $x = 0$ of

   $y" + y = 0.$ **(16 marks)**
2. Find the first four terms in each portion of the series solution around $x_0 = 0$ for the following differential equation $(x^2+1)y'' - 4xy' + 6y = 0$ **(12 marks)**
3. Find the eigenvalues and eigenfunctions of

   $y'' - 4\lambda y' + 4\lambda^2 y = 0; y'(1) = 0, y(2) + 2y'(2) = 0$ **(12 marks)**
4. Verify the orthogonality property for the Sturm-Liouville problem

   $y'' + \lambda y = 0; y'(0) = 0, y(\pi) = 0$ if the problem has the eigenvalues

   $\lambda_n = \left(n - \frac{1}{2}\right)^2$ corresponding to the eigenfunctions

   $y_n(x) = A_n \cos\left(n - \frac{1}{2}\right)x,\ n = 1,2,\ldots$ **(12 marks)**
5. Find a Fourier cosine series for $f(x) = x$ on (0, 3). **(12 marks)**
6. Find a Fourier cosine series for $f(x) = e^x$ on $(0, \pi)$. **(12 marks)**