THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

P.O. Box 62157
00200 Nairobi - KENYA
Telephone: 891601-6
Fax: 254-20-891084
E-mail:academics@cuea.edu

MAIN EXAMINATION

MAY – JULY 2018 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

PART TIME PROGRAMME

MAT 233: ORDINARY DIFFERENTIAL EQUATIONS I

Date: JULY 2018	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) Define a differential equation **(2 marks)**

b) State the order and degree of the following differential equation

$K^3\left[\frac{d^2y}{dx^2}\right]^4 = \left[1-\left(\frac{dy}{dx}\right)^3\right]^3$ **(2 marks)**

c) Check for exactness and solve the differential equation

$ysinxdx-(1+y+cosx)dy=0$ **(6marks)**

d) Solve the Bernoulli differential equation

$\frac{dy}{dx}+y=xy^3$ **(8marks)**

e) Solve the differential equation

$y''-10y'+25y=0$ **(4marks)**

f) Solve the homogeneous equation $\frac{dy}{dx}=\frac{x-y}{x+y}$ **(8marks)**

Q2. a) Using the method of separation of variables, solve the initial value problem $xsinydx+(x^2+1)cosydy=0$ given that y(1) $=\frac{\pi}{2}$ **(10 marks)**

b) Solve the linear differential equation $(x+1)\frac{dy}{dx}+y=e^{3x}(x+1)^2$ **(10 marks)**

Q3. a) Solve the following non-homogeneous differential equation

$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 2sin4x$ **(10 marks)**

b) Solve the following differential equation

$y^{(4)} - 4y''' - 5y'' + 36y' - 36y = 0$ **(10 marks)**

Q4. a) Use the method of variation of parameters to solve the differential equation

$y''' + y' = \tan x - \frac{\pi}{2} < x < \frac{\pi}{2}$ **(12 marks)**

b) A body is originally at 80^0c. it cools down to 60^0c in 20 minutes. The surrounding temperature is40^0c .what will be the temperature of the body after 40 minutes from the origin? **(8marks)**

Q5. A lake has various streams flowing into it and flowing out of it, the total rates of influx and efflux being equal. For a long time, the streams flowing into the lake are polluted, and pollution in the lake built up to an undesirable level. However, as a result of conservation efforts, the sources of pollution in the streams were eliminated and now only pure water flows into the lake. If the volume of the lake is Vkm^3, if the rate of influx and efflux is $R\ km^3/_{year}$ and if the pollutants are always uniformly distributed throughout the lake,

a) Obtain the formula for the time it will take for the pollution in the lake to be reduced:
   i) To one-half its level at the time of the clean-up and
   ii) To one-tenth its level at the time of clean up **(15 marks)**

b) Determine the numerical time values for theLake Erie and Lake Ontario given the following data. **(5marks)**

	$V(km^3)$	R out $(km^3/_{year})$	At A=$\frac{1}{2}$	At $A = \frac{1}{10}$
Lake Erie	460	175	?	?
Lake Ontario	1600	209	?	?

END