

**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**Plot 91, Cadastral Zone, NnamdiAzikiwe Expressway, Jabi, Abuja.**

**FACULTY OF SCIENCES**

**JULYEXAMINATION 2017\_1**

**Course Code: MTH 308**

**Course Title: Mathematical Modeling**

**Credit Unit: 2**

**Time Allowed: HOURS**

**Total Marks: 70**

**Instruction: ATTEMPTQUESTION ONE(1) AND ANY OTHER THREE (3) QUESTIONS**

1. (a) Define Mathematical Modelingwith examples. **(5 Marks)**

(b)The equation for the law of natural growth is a first order first degree linear differential equation given by

where x(t) is the population size at any time and k is the constant of proportionality, what is the solution of this equation?. **(6 Marks)**

(c) In a certain culture of bacteria the rate of increase is proportional to the number present.

(i) if it is found that the number doubles in 4 hours, how many may be expected at the end of 12 hours.

(ii) if there are 104 at 3hours and 4 x 104 at the end of 5 hours, how many were in the beginning. **(10 Marks)**

d) Mention and discuss with examples types of modeling **(4 Marks)**

1. a) Differentiate between Mathematical Model and Mathematical modeling **(4 Marks)**

b) If the population of a country doubles in 50 years, in how many years will it treble under the assumption that the rate of increase is proportional to the number of inhabitants.**(11marks)**

**3.** (a) A pendulum executing small vibrations has period P and length 1, and m is the mass of the

bob. Can P depend only on l and m? If we assume P depends on l and the acceleration g due to gravity, then show that , where C is constant. **(6 Marks)**

b) If radium decomposes at a rate proportional to the quantity of radium present. Suppose that it is found that in 25 years approximately 1.1% of a certain quantity of radium has decomposed. Determine approximately how long will it take for one-half of the original amount of radium to decompose. **(9Marks)**

**4.**At time t = 0 an amount of heat energy e, concentrated at apoint in space, is allowed to diffuse outward

into a region with temperaturezero. If *r* denotes the radial distance from the source and *t* is time:

a) Find the dimensionless quantity that can be formed **(9 Marks)**

b) Determine the temperature u as a function of *r* and *t* **(6 Marks)**

1. (a) The equation of the newton’s law of cooling is a first order first degree linear separable differential equation given by  where T is the temperature of the body, *TA* is the temperature of the surrounding medium and *k* is the constant of proportionality; Find the solution of this equation**.(4 Marks)**
2. A copper ball is heated to a temperature of 100oC. Then at time =0 it is placed in water which is maintained at a temperature of 30oC. At the end of 3mins the temperature of the ball is reduced to 70oC. Find the time at which the temperature of the ball drops to 31oC **(11 Marks)**