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**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE**

**IN ACTUARIAL SCIENCES**

**1ST YEAR 1ST SEMESTER 2016/2017 ACADEMIC YEAR**

**(REGULAR) MAIN CAMPUS**

**COURSE CODE: SAC 103**

**COURSE TITLE: MATHEMATICAL MODELLING**

**EXAM VENUE: STREAM: Bsc. Actuarial**

DATE: EXAM SESSION:

TIME: 2.00 HOURS

**Instructions:**

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**QUESTION ONE (20 MARKS)**

1. Outline FOUR advantages of modeling (4 Marks)
2. Identify the order of the following difference equations. (3 Marks)
3. 
4. 
5. 
6. Suppose a cup of tea initially at a temperature of 1800F is placed in a room which is held at a constant temperature of 800F. Suppose after one minute the tea has cooled to 1750F. What will be the temperature after 20 minutes? (5 Marks)
7. i. Show that is a solution to the following differential equation.

 (3 Marks)

ii. Show that is a solution to the following differential equation.

for 

1. The population of a community is known to increase at a rate proportional to the number of people present at T(t). If the population has doubled in 6 years, how long will it triple?

(7 Marks)

1. Find the solution to  (5 Marks)

**QUESTION TWO (20 MARKS)**

1. Explain FIVE different categories of mathematical models (10 Marks)
2. i. Solve the difference equation of the form given in the initial condition and  (6 Marks)

ii. Using the above solution in b (i). Find for  (4 Marks)

**QUESTION THREE (20 MARKS)**

1. A body is discovered at 6.00 a.m. one morning in an apartment. The temperature of the body was found to be 320C, the room was air conditioned at a constant of 200C. Assuming that the difference between the body and the surrounding temperature dropped at 6% per hour. At what time did the murder occur? (Normal body temperature was 380C) (10 Marks)
2. The population of a colony of bee at the moment is 50,000, birth rate is 5% and death rate is 4% per week.
3. Estimate the population after one hour. (8 Marks)
4. How long will it take the population to double? (2 Marks)

**QUESTION FOUR (20 MARKS)**

 A 1500 gallon tank initially containing 600 gallons of water with 5lbs of salt dissolved in it. Water enters the tank on a rate of 9gallons per hour and water entering the tank has a salt concentration of lbs/gal. If a well mixed solution leaves the tank at a rate of 6 gallons per hour, how much salt is in the tank when it overflows?

**QUESTION FIVE (20 MARKS)**

1. Solve the following initial value problem

for (10 Marks)

1. Outline THREE objective of modeling (3 Marks)
2. Consider the following model of a closed economy; -Output, Consumption and Investment

 (i)

 (ii)

 (iii)

1. Condense the model into a difference equation involving output and comment on its properties. (4 Marks)
2. Solve the equilibrium output assume when  (3 Marks)