RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences

First Year - Semester II Examination – September/October 2020

MAA 1104 – MATHEMATICAL MODELLING

Time: One (1)hour

Calculators will be provided

Answer two (2) Questions with Question no 1.

1. Answer the following questions.

   a) Write down two advantages and two disadvantages of mathematical modelling. **(20 marks)**

   b) In a particular day there are 1000 birds in an island. They breed with a constant continuous growth rate of 10% per year. How many birds will be in the island after seven years from that particular day? **(20 marks)**

   c) Consider birds migrate at a constant rate of 100 new arrivals per year for the same island as described in b. Calculate the number of birds in the island after seven years. **(20 marks)**

   d) You take an ice-cream from the freezer which is kept at -18° C. Outside temperature is 32° C. After one minute, the ice-cream has warmed to -8° C. What is the temperature of the ice-cream after five minutes? **(20 marks)**

cont.

e) Consider a Tower of Hanoi with three rods and n disks. Find the number of moves for first three disks by obeying the rules and obtain an expression for the number of moves for n disks. **(20 marks)**

2. a) You are given a very hot sample of metal and asked to measure its temperature. You have a thermometer but it only measures up to 200° C and the metal is hotter than that. You leave the metal in an environment with a temperature of 20° C. After six minutes it has cooled sufficiently that you can measure its temperature (80° C). After another two minutes the temperature has reduced to 50° C. What was the initial temperature of the metal?

(40 marks)

b) Suppose an organism has 20g of ^{14}C at the time of its death. Approximately how much ^{14}C remains after 10320 years? (The half-life of ^{14}C is 5700 years) **(30 marks)**

c) If 12% of the initial amount of ^{14}C in a sample remains, how much time has elapsed? (The half-life of ^{14}C is 5700 years) **(30 marks)**

3. a) Pure water is falling into the tank at the rate of 10 *l*/min. The contents of the tank are kept thoroughly mixed, and the contents flow out at 10 *l*/min. Salt is added to the tank at the rate of 0.1 kg/min. Initially, the tank contains 10 kg of salt in 100 *l* of water. How much salt is in the tank after 30 minutes? **(35 marks)**

b) One of the product firms estimates that its daily total cost function (in suitable units, x) is $TC(x) = x^3 - 6x^2 + 13x + 15$ and its total revenue function is $R(x) = 28x$. Find the value of x that maximizes the daily profit. **(35 marks)**

c) In a product firm, quantity demand function is given by, $q_d = 240 - 2p - 15p^2$. Find the price elasticity(ε) of the demand function, where p = 20. Discuss your answer.

(30 marks)

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