



The Open University of Sri Lanka  
 B.Sc. Degree Programme-Level -04  
 Final Examination-2012/ 2013  
 AMU2183/ AME4183-Mathematical Modelling III  
 Applied Mathematics

**Duration: Two Hours.**

Date: 22.06.2013

Time: 09.30a.m.-11.30a.m.

**Answer Four Questions only.**

1. A certain religious organization has decided to donate blankets and mattresses among those who have been affected by Tsunami disaster. They selected 19 families from Matara district. The decision was a family to receive a blanket or a mattress but not both. This organization has allocated SR.1500 for this purpose. It was revealed that the price of a blanket is SR.40 less than that of a mattress.

Find

- The number of families who can receive a mattress.
  - The number of families who can receive a blanket.
  - The cost of a blanket.
  - The cost of a mattress.
- (SR-Saudi Riyal)

2. What are the assumptions made in the derivation of the formula  $k \frac{d^2y}{dx^2} = -M$  for bending of beams?

A beam of length  $l$  weighing  $w$  per unit length rests on three supports two at each end and one at centre. If the ends and the centre of the beam are on the same level, find the load carried by each support.

3. Strontium disintegrates at a rate proportional to the amount present at any instant. If  $w_1$  and  $w_2$  grams of strontium are present at times  $t_1$  and  $t_2$  respectively, show that the half life of strontium is,

$$\frac{(t_2 - t_1) \ln 2}{\ln \left( \frac{w_1}{w_2} \right)}$$

Given that the half-life period of strontium is 25 years, estimate the time taken for the mass to be reduced to three quarters of the original mass.

4. A water tank has to be constructed with galvanized iron sheets to have a given volume of  $V\text{m}^3$ . It is either to be rectangular of dimensions  $a$ ,  $b$  and  $c$  or cylindrical of base radius  $r$  and height  $h$ , where lengths are measured in meters and are to be chosen suitably. If the tanks are closed except for two small apertures, one for the water to be pumped in and the other for water to be taken out, and the cost of making a curved surface is  $x$  times that of making a plane surface, obtain an expression for the ratio of minimum cost of making the rectangular tank to that of making the cylindrical tank. Assume that the cost depends purely on the surface area. What is the critical value of  $x$  which decides whether the tank is to be rectangular or cylindrical?
5. (a) A student carrying a flu virus returns to an isolated college hostel of 1000 students. Suppose that the rate at which the virus spreads is proportional not only to the number of infected students  $N_i(t)$ , but also to the number of students not infected at time point  $t$  (in days). After 4 days the virus has infected altogether 50 students. Find the number of infected students after 6 days. Suppose that any student in the hostel is able to get infected with the disease.
- (b) How many days would it take for half of the students in the hostel to get infected?
6. A grandson of an old grandmother wishes to pay off all the debts of his granny. It was found out that she had taken a loan of Rs.150,000 from a bank 20 years ago, at an interest rate of 12% compounded monthly which has to be paid over a period of 30 years. Suppose the grandmother has paid the monthly payments over the past 20 years as agreed upon with the bank.
- (a) What has been her monthly equal payment?  
(b) How much money has she paid so far in order to settle this loan?  
(c) How much money does he need to pay to settle the loan entirely?

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