UNIVERSITY OF COLOMBO, SRI LANKA

FACULTY OF MANAGEMENT AND FINANCE

Bachelor of Business Administration (Level I – Semester I) Examination (Repeat)

June 2017

BEC 1300 Business Mathematics

Three (03) Hours

Answer All Questions

Use of Calculators is Allowed.

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1. *CHIKABUROWA SPORTS* are producing cricket gloves for many years. It is a very famous brand among all the cricket players around the world.

   CHIKABUROWA is regularly maintaining data on their annual production, sales and expenditure. Using the data on production, they estimated the average cost function for the firm as

$$AC = \frac{2}{3}X^2 - 8X + 122 + \frac{10}{X}$$

   where X denotes the level of output.

   They used their sales data to estimate the demand function and is given by

$$2P + 7X = 350$$

   Where P is the price per unit of output.

   The new government appointed in the last general election decided to impose a tax of Rs. 18/- per each sport item produced in the country. *CHIKABUROWA SPORTS* also needs to pay the tax and they decided to add it to their cost.

   i.   With the new production tax introduced by the government, obtain the new average cost function AC_i.

   (02 Marks)

ii. Hence or otherwise obtain the total cost function, TC.

(02 Marks)

iii. Obtain the total revenue function TR.

(04 Marks)

iv. Obtain the profit function, π.

(03 Marks)

v. Differentiate the profit function with respect to X, and find out at what value of X, $\frac{d\pi}{dX}$ will be zero.

(04 Marks)

vi. Obtain the second derivative of the profit function and show that the value you obtained for X in part (v) above will maximize the profit function.

(03 Marks)

vii. Find the minimum profit.

(02 Marks)

(Note: All above measurements are measured in 1000 units)

(Total : 20 marks)

2. *SUPER FRESH BLEND* is a very popular tea product produced by the *NUGAWELA PLANTATIONS*. They pack 1kg of tea leaves in a cylindrical shaped container of radius 'r' and height 'h' made up of very costly material.

> *Area of the circle =* πr^2
>
> *Perimeter of a circle =* $2\pi r$

i. Write down a formula for the volume 'V' of the container.

(02 Marks)

ii.   If each container is required to be designed to have a capacity of 269.5 cm^3, show that the height 'h' of the cylinder is given by

$$h = \frac{539}{2\pi r^2}$$

(02 Marks)

iii.   Obtain a formula for the total surface area 'A' of the container in terms of both 'h' and 'r'.

(02 Marks)

iv.   By using the relationship between 'h' and 'r' you establish in part (ii) above, show that A can be expressed as

$$A = 2\pi r^2 + \frac{539}{r}$$

(02 Marks)

v.   Due to the high cost of material used for the container, it is necessary to minimize the total surface area of the container. Differentiate 'A' with respect to 'r' and find out at what value of 'r', the derivative $\frac{dA}{dr}$ will equate to zero.

(05 Marks)

vi.   Obtain the second derivative of 'A' with respect to 'r' and show that the value you obtained for 'r' in part (v) above, will minimize the total surface area of the container.

(04 Marks)

vii.   What will be the amount of the material required for one such container?

(03 Marks)

(Total : 20 marks)

3.   Riswi Thakushika, a medium-scale manufacturer, employs 60 skilled men and 90 semi-skilled men to make an article in two standards, a deluxe model and an ordinary model. The making of a unit in deluxe model requires two hours work of skilled labour and one hour work of semi-skilled labour. A unit of ordinary model requires one hour work of skilled labour and

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three hours work of semi-skilled labour. According to the government regulations, any employee is not allowed to work more than 8 hours per day. Per unit profits of deluxe and ordinary models are Rs. 1000/- and Rs. 800/- respectively. Riswi Thakushika awaits your assistance in deciding the most profitable product mix of his articles.

i. By taking the number of units to be produced in deluxe model per day as X and the number of units to be produced in ordinary model per day as Y, write down the objective function for Riswi Thakushika.

(02 Marks)

ii. Obtain the necessary constraints to be satisfied in reaching the objective you decided in part (i) above.

(06 Marks)

iii. Using the graphical method obtain the feasible region satisfied by all the constraints.

(07 Marks)

iv. Insert the objective function with profit level of Rs. 320,000 in the same graph.

(02 Marks)

v. Hence or otherwise obtain the most profitable product mix for Riswi Thakushika.

(02 Marks)

vi. What will be the maximum profit Riswi Talkushika can attain?

(01 mark)

(Total : 20 Marks)

4. A contractor undertakes to supply diesel engines to a truck manufacturer at a rate of 40 engines per day. He noticed that the cost of holding a complete engine in stock is Rs. 2400 per month. Production of engines is in batches and each time a new batch is started there is a set up cost of Rs. 30,000. During the period of production he will be able to produce 60 such engines per day.

i. Sketch a diagram to show clearly the above information by taking the optimum lot size as 'q', the maximum inventory level as 'I_m' and the optimum scheduling period as 't'.

(04 Marks)

ii. Using the sketch you have drawn in part (i) and the information given above, show that the total cost per unit time can be given by

$$TC = \frac{30,000}{t} + 1200I_m$$

(02 Marks)

iii. Using the sketch you have drawn in part (i) and the information given above, express the maximum inventory level 'I_m' and the optimum scheduling period 't' in terms of the optimum lot size 'q''.

(04 marks)

iv. Using the relationships you derived in part (iii) above and the expression you obtained for total cost in part (ii) above, express the total cost function in terms of only one variable q.

(03 Marks)

v. By differentiating the total cost function with respect to 'q', obtain the optimum lot size per production run.

(05 Marks)

vi. Hence obtain the formula for the optimum scheduling period.

(02 Marks)

(Total : 20 marks)

5. *SUJIMIKA ELECTRONICS* is producing household electronic items including Refrigerators, Washing Machines, Colour Television Sets etc. People can purchase these items at *SUJIMIKA OUTLETS* by making an outright payment or making a down payment of 10% of its marked price and the balance in equal monthly installments over a period of three years. For the balance payments make through installments *SUJIMIKA* is charging an interest at a rate of 15% per annum compound monthly.

Mr. Jinadasa Galappaththi is planning to purchase a Washing Machine worth of Rs. 85,000 and wishes to make the payments through installments.

i. What will be the initial payment and the present value of the balance to be paid in installments?

(02 marks)

ii. Assuming each installment is worth 'P' rupees, calculate the present value of the first two installments and the last two installments.

(04 Marks)

iii. Hence or otherwise, calculate the value of the monthly installment

(Round off the answer to the nearest rupee)

(06 Marks)

Mr. Jinadasa Galappaththi, is expected to receive a salary arrears, after two years from his purchase of the Washing Machine and he decides to use it to pay off the balance.

iv. Calculate, at the end of the first two years, the Future Value of the initial balance (marked price – down payment) of the Washing Machine.

(02 Marks)

v. Calculate, at the end of the first two years, the Future Value of the sum of all the installments paid within first two years.

(05 Marks)

vi. What will be the balance to be paid at the end of the first two years to settle the loan.

(01 Marks)

(Total : 20 Marks)