Session : August 2015
Programme : Diploma In Business (DIB)
Course : MAT1106: Business Mathematics
Date of Examination : December 7, 2015
Time : 11.00am – 1.00pm  Reading Time : Nil
Duration : 2 Hours

Special Instructions :

Answer any FIVE (5) structured-type questions.

Materials permitted : Non-Programmable Calculator
Materials provided : Formula sheet, Graph paper

Examiner(s) : Mr. Dinesh Kumar, Ms. Saemila Devi, Mr. Josh Si Chong En,
Mr. Foo Kai Pin, Ms. Fang Yen Yen, Mr. Billy Siew Woo Bing,
Mr. Wong Sin Wei

Moderator : Dr. Ch’ng Pei Eng

This paper consists of 5 printed pages, including the cover page
DIPLOMA IN BUSINESS (DIB)
MAT1106 BUSINESS MATHEMATICS
FINAL EXAMINATION: AUGUST 2015 SESSION

Instructions: This paper consists of SIX (6) structured-type questions. Answer FIVE (5) out of SIX structured-type the questions in the answer booklet provided. All questions carry equal marks of 20 marks.

Question 1

(a) Simplify the following:

(i) \(2\sqrt{32} - \frac{\sqrt{72}}{3}\)  

(ii) \(\left(\frac{6x^{-3}y^{-1}}{3x^{-2}y^4}\right)^2\)  

(b) Expand: \((x - 3)(x + 3)^2\)

(c) Factorize the expression completely: \(4x^3 - 32\).

(d) Simplify: \(\frac{x}{x-1} - \frac{x}{x^2-1}\)

(e) Solve the quadratic equation by using formula: \(2x^2 = 4x + 1\)

Question 2

(a) Given that \(f(x) = x - 4\) and \(g(x) = x^2 - 1\), find

(i) \(f(-1) - g(-2)\).  

(ii) the value(s) of \(x\) if: \(f[g(x)] = 4\)

(b) Write an equation of a line which is parallel to the line \(y = 3x + 6\) and passing through the point \((1, -6)\).

(c) Given \(f(x) = x^2 - 4x - 12\), sketch the graph of \(f(x)\) by indicating the vertex point, \(y\) - intercept and \(x\) - intercept clearly.

(d) Rationalize the denominator: \(\frac{2 - \sqrt{5}}{2 + \sqrt{5}}\)
Question 3

(a) Differentiate the following with respect to $x$:

$$y = (-6x^2 - 1)^{\frac{1}{3}}$$

(3 marks)

(b) A stationery supply company sells $x$ whiteboard markers per year at RM$p$ per marker. The demand equation for these markers is $p = 10 - 0.001x$. The total annual cost, $C(x)$ in RM, of manufacturing $x$ whiteboard markers for the stationery supply company is given by, $C(x) = 5000 + 2x$

(i) Find the revenue function.

(1 mark)

(ii) Express the company's profit as a function of $x$.

(2 marks)

(iii) Determine the production level that earns the company maximum profit, and find the price for each marker at this level.

(4 marks)

(iv) Find the company’s maximum profit.

(2 marks)

(c) Evaluate the integral $\int_{1}^{2} (3x^4 + x^2 - 5) \, dx$.

(5 marks)

(d) Given that $x, x + 3, 4x, ...$ are the first three terms of an arithmetic progression. Find the value of $x$.

(3 marks)

Question 4

(a) A zero-coupon (noninterest-bearing) bond can be redeemed in 10 years for RM 1,000. How much should you be willing to pay for it now if you want a return of

(i) 8% compounded monthly?

(3 marks)

(ii) 7% compounded continuously?

(3 marks)

(b) Dr Ravin bought a house for RM 560,000. He made a 10% down payment and financed the balance through a bank for 30 years.

(i) If the interest rate was 7.5% compounded monthly, find the monthly payment that Dr Ravin made to settle the loan.

(4 marks)

(ii) Suppose Dr Ravin missed the first three payments. How much should be paid on the fourth month if he wanted to settle the outstanding arrears?

(3 marks)
(iii) Immediately after paying for 10 years, Dr Ravin wants to settle the loan in full. How much is the amount that needs to be paid? (3 marks)

(c) Given the first term of a geometric progression is 0.8 and the fifth term is 500, Find the 7th term of the progression. (4 marks)

Question 5

(a) Given matrix \( A = \begin{pmatrix} -2 & 0 \\ 4 & -1 \end{pmatrix} \) and \( B = \begin{pmatrix} 7 & 3 \\ -5 & 6 \end{pmatrix} \).

(i) Find \( 2B + A^T \) (3 marks)

(ii) Find \( 2BA \) (3 marks)

(b) Solve the system of equations by using any matrices method:

\[
\begin{align*}
4x - 3y &= 15 \\
2x + y &= 5
\end{align*}
\] (4 marks)

(c) The revenue and cost function in ringgit of a product are given as:

\[
\begin{align*}
R(x) &= 600x - x^2 \\
C(x) &= 200 + 6x + 2x^2
\end{align*}
\]

Determine the break even quantity. (5 marks)

(d) Find the amount to be invested every three months at 10% compounded quarterly to accumulate RM 10,000 in three years. Find the interest earned. (5 marks)

Question 6

(a) If \( P = 3x + 2y \), find the maximum value of \( P \) subject to the given constraints:

\[
\begin{align*}
2x + y &\leq 6 \\
x &\leq 2 \\
2x + 3y &\leq 12 \\
x &\geq 0, y &\geq 0
\end{align*}
\] (6 marks)
(b) The table below shows the sales of a toy robot over the last 11 months.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sales</td>
<td>365</td>
<td>401</td>
<td>387</td>
<td>350</td>
<td>330</td>
<td>310</td>
<td>298</td>
<td>310</td>
<td>320</td>
<td>345</td>
<td>350</td>
</tr>
</tbody>
</table>

(i) Use a three-month moving average for the department store sales to forecast for the month 9 and thus find the forecast error for the month 9. (3 marks)

(ii) Use a five-month moving average for the department store sales to forecast for the month 12. (2 marks)

(c) Find the relative maximum and relative minimum of the function \( f(x) = x^3 - 3x^2 \). (6 marks)

(d) Find the inverse of \( A = \begin{bmatrix} 2 & -3 \\ 4 & -5 \end{bmatrix} \). (3 marks)

~THE END~

MAT1106(F) August 2015
1) Quadratic Formula: \[ \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

2) Vertex of a parabola: \( f(x) = ax^2 + bx + c \) : \( \left[ -\frac{b}{2a}, f\left(-\frac{b}{2a}\right) \right] \)

3) Differentiation properties:

\[ \frac{d}{dx} x^n = nx^{n-1} \]

\[ \frac{d}{dx} [f(x)g(x)] = f(x)g'(x) + f'(x)g(x) \]

\[ \frac{d}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2} \]

4) Integration properties:

\[ \int z^r dz = \frac{z^{r+1}}{r+1} + C \]

\[ \int_{a}^{b} f(x) \, dx = F(b) - F(a). \]

5) Compound interest: \( A = p(1 + \frac{r}{k})^{kt} \)

6) Continuous compound interest: \( A = Pe^{rt} \)

7) Arithmetic sequences:
   
   i. \( a_n = a_1 + (n - 1)d \)

   ii. \( S_n = \frac{n(a_1 + a_n)}{2} \)
8) **Geometric sequences:**

   i. \[ a_n = a_1 r^{n-1} \]

   ii. \[ S_n = \frac{a_1 - a_1 r^n}{1-r} \quad r < 1 \]

9) **Simple interest**: \[ I = Prt \]

10) **Future value**: \[ FV = PMT \frac{(1+i)^n-1}{i} \]

11) **Sinking fund**: \[ PMT = FV \frac{i}{(1+i)^n-1} \]

12) **Present value**: \[ PV = PMT \frac{1-(1+i)^{-n}}{i} \]

13) **Amortization**: \[ PMT = PV \frac{i}{1-(1+i)^{-n}} \]

14) **Inverse matrix**: \[ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} \]