FINAL
Examination Paper
(COVER PAGE)

Session : APRIL 2014

Programme : Foundation in Business Information Technology (CFPI)

Course : MAT1215: FUNDAMENTAL OF MATHEMATICS

Date of Examination : 24th July 2014

Time : 11.00am – 1.00pm  Reading Time: Nil  2 Hours

Special Instructions :

This paper consists of SIX (6) questions.

Answer any FIVE (5) questions out of SIX (6) structured questions.

Materials permitted : Non-Programmable Calculator

Materials provided : Graph Paper, Formula Booklet 1

 Examiner(s) : Mr. Tan Seng Kuan & Ms. Taamaraiselvi

Moderator : Dr. Ng Set Foong

This paper consists of 6 printed pages, including the cover page.
Instructions: This paper consists of SIX (6) questions. Answer any FIVE (5) questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) From the set of \([-\sqrt{5}, -1, -\frac{1}{2}, 2, \sqrt{7}, 6, \sqrt{\frac{625}{9}}, \pi]\), identify the set of:

(i) Natural numbers

(ii) Rational numbers

(iii) Irrational numbers

(iv) Integers (4 marks)

(b) Simplify and write your answers without using negative exponents.

(i) \(\frac{-18r^3s^2}{5} \left(\frac{2r^4s}{3}\right) \left(\frac{30rs^3}{2r}\right)\) (3 marks)

(ii) \(\frac{9ab^3 \cdot 14xy^2}{7xy} \div \frac{18a^2b^2x}{27z^3}\) (3 marks)

(iii) \(\frac{(27x^3y)^{\frac{1}{2}}}{(8xy^2)^{\frac{3}{2}}}\) (3 marks)

(c) Factorize the following:

(i) \(x^3 - 27y^3\) (3 marks)

(ii) \(4a^2 - (b - c)^2\) (2 marks)

(iii) \(5a^3 - 10a^2 + 6a - 12\) (2 marks)
Question 2

(a) Given the following expression, 

(i) simplify and express using positive exponents: 
\[
\left( \frac{x^2 y^6 z^2}{\sqrt{x^4 z^{-2}}} \right)^2
\]  (2 marks)

(ii) rationalize the denominator and simplify: 
\[
\frac{\sqrt{7} - \sqrt{2}}{\sqrt{2} + \sqrt{7}}
\]  (3 marks)

(iii) simplify as completely as possible: 
\[
\sqrt{2} \left( \sqrt{2y} - 3\sqrt{3} \right)
\]  (2 marks)

(b) Given that \( f(x) = \frac{2x - 10}{5x} \) and \( g(x) = 8x - 9 \). Find 

(i) \((f - g)(x)\)  (2 marks)

(ii) \((g \circ f)(x)\)  (3 marks)

(iii) \(f^{-1}(x)\)  (3 marks)

(c) Solve the following quadratic equations: 

(i) \((x - 5)^2 = 81\)  (2 marks)

(ii) \(4x^2 + 4x - 8 = -1\)  (3 marks)

Question 3

(a) Given the function \( f(x) = 2x^2 - 3x - 4 \),

(i) find the vertex, indicating whether it is minimum or maximum.  (2 marks)

(ii) find the x- and y- intercepts.  (3 marks)

(iii) sketch the graph by showing the vertex, the x-intercepts and the y-intercept clearly.  (3 marks)
(b) Given the following arithmetic sequence:
\[
\frac{1}{2}, \frac{7}{6}, \frac{11}{6}, \frac{5}{2}, \ldots
\]
(i) find the 20th term. 
(ii) find the sum of the first 20 terms. 

(3 marks) 

(3 marks)

(c) Given the following geometric sequence:
128, 64, 32, ....
(i) find the 7th term of the sequence. 
(ii) find the sum of the first 8 terms.

(3 marks) 

(3 marks)

Question 4

(a) If \[
\begin{pmatrix}
2 & a & b \\
1 & 0 & -3 \\
0 & 3 & 2
\end{pmatrix}
= \begin{pmatrix} 1 \\ 0 \\ b \end{pmatrix},
\] find the values of \(a\) and \(b\). 

(4 marks)

(b) If \(A = \begin{pmatrix} -1 & -3 \\ 1 & 1 \end{pmatrix}, B = \begin{pmatrix} 6 & 3 \\ 2 & 1 \end{pmatrix}, C = \begin{pmatrix} 1 & 3 \\ 2 & 0 \end{pmatrix}\) and \(D = \begin{pmatrix} 1 & 2 & 1 \\ 0 & 1 & -1 \end{pmatrix}\),
find
(i) \(2B - A\)
(ii) \(DC\)
(iii) the matrix \(X\) if \(2X - A^{-1} = B\)

(3 marks) 

(3 marks) 

(5 marks)

(c) Solve the following system of equations by the inverse matrix method:
\[
\begin{align*}
3x - 2y &= -3 \\
4x - y &= 7
\end{align*}
\]

(5 marks)
Question 5

(a) Given the following system of linear inequalities:

\[
\begin{align*}
3x &+ y \leq 9 \\
x &+ 3y \leq 7 \\
x &\geq 1 \\
y &\geq 0
\end{align*}
\]

(i) Graph the solution set and indicate whether it is bounded or unbounded. (3 marks)

(ii) Determine the coordinates of the corner points. (3 marks)

(iii) Using the corner points, find the optimal solution for the objective profit function: \( P(x) = 4x + 10y \). (2 marks)

(b) Given the equation of a curve is \( y = x^3 + 3x^2 - 9x + 6 \).

(i) Find \( \frac{dy}{dx} \). (1 mark)

(ii) Find \( \frac{d^2y}{dx^2} \). (1 mark)

(iii) Find the coordinates of the turning points. (3 marks)

(iv) Hence, determine whether each turning point is a maximum or minimum point. (2 marks)

(c) (i) Integrate with respect to \( x \):

\[
(\sqrt{x} - x)^2
\]

(2 marks)

(ii) Evaluate:

\[
\int_1^2 (3x + \frac{1}{x^2} - \frac{1}{x^4}) \, dx
\]

(3 marks)
Question 6

(a) The price-demand equation and the cost function for an item manufactured by an electronic company are given, respectively, by

\[ p + 0.2x = 100 \quad \text{and} \quad C(x) = 800 + 30x \]

where \( x \) is the number of units manufactured, \( p \) is the price per unit and \( C(x) \) is the total cost (in RM) of producing \( x \) units. Find

(i) the revenue function, \hspace{1cm} (2 marks)

(ii) the profit function, \hspace{1cm} (2 marks)

(iii) the marginal profit function, \hspace{1cm} (2 marks)

(iv) the maximum profit obtained and the number of items that need to be manufactured. \hspace{1cm} (2 marks)

(b) Ahmad has RM5000 and wishes to save it in a bank for 5 years. The bank offers two options to him:

Option A: 8.5% interest compounded annually,
Option B: 8% interest compounded continuously.

Which option should Ahmad choose and what is the difference in the amount received after 5 years between both options? \hspace{1cm} (5 marks)

(c) The Pre-University Centre of a college has 16 lecturers. The Centre has been asked to choose 5 of its lecturers to serve on an academic committee.

(i) In how many ways can the committee members be chosen? \hspace{1cm} (2 marks)

(ii) If 7 of the 16 lecturers are female, how many five-member committees can be formed in which exactly 2 of the members are female? \hspace{1cm} (2 marks)

(iii) If 4 of the lecturers have a doctorate degree, how many five-member committees can be formed in which at most 2 of the members have a doctorate degree? \hspace{1cm} (3 marks)