Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date 01 December 2008

CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE	:	FKB 23302
SUBJECT TITLE	:	ENGINEERING MATHEMATICS 3
LEVEL	:	BACHELOR
TIME / DURATION	:	8.00pm – 10.00pm (2 HOURS)
DATE	:	11 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. You are required to answer FOUR (4) questions only.
6. Answer all questions in English.
7. Fomula is appended.

THERE ARE 3 PAGES OF QUESTIONS AND 4 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

(Total : 60 marks)

INSTRUCTION : Answer FOUR (4) questions only.
Please use the answer booklet provided.

Question 1

FIGURE 1 below shows a portion of several squares drawn consecutively.

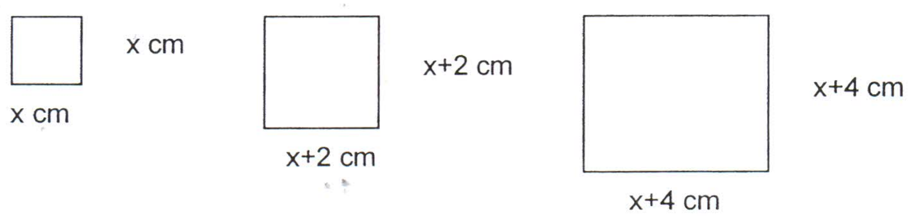

FIGURE 1

The perimeters of the squares form an arithmetic progression. The length of the first square is x cm and the length of the other consecutive squares differ from each other by 2 cm. Given that the sum of the first five perimeters of the squares is 320 cm. Calculate

(a) the length of the first square. (5 marks)

(b) the sum of the first 300 perimeters of the squares. (3 marks)

(c) the number of terms needed to make the sum of the perimeters of the squares equal to 11760. (7 marks)

Question 2

(a) Expand $(9-4x)^{\frac{5}{2}}$ as series of ascending powers of x up to and including the term in x^3. (5 marks)

(b) Determine the first term and the14th term in the binomial expansion $\left(2-\frac{1}{5}x\right)^{26}$, correct to 6 significant figures. (5 marks)

(c) Use the Maclaurin's series expansion to expand $\frac{(1+2x+3x^2)}{e^{2x}}$ in ascending powers of x up to and including the term in x^5. (5 marks)

Question 3

Determine the particular solution to the differential equation

$$(x^2+1)y'' + (x^2-1)y = 0 \qquad \textit{given that } y(0)=1\,,\ y'(0)=0$$

and write down the first four nonzero terms of the series solution. (15 marks)

Question 4

(a) Determine the centre, radius and interval of convergence (if they exist) for

$$\sum_{n=1}^{\infty}(-1)^{n}\frac{n^{2}}{(n+1)!}(x+3)^{n}$$

(9 marks)

(b) Determine whether the series $\sum_{n=1}^{\infty}\frac{n^{3}+1}{2^{n}+1}$ converges or diverges.

(6 marks)

Question 5

Solve the given difference equation using Z-Transform

$$y_{n+2}+y_{n}=2 \quad if \quad y_{0}=0 \quad y_{1}=0$$

(15 marks)

END OF QUESTION

APPENDIX 1

MACLAURIN SERIES FOR COMMON FUNCTIONS

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + x^4 + x^5 + \ldots \text{ for } -1 < x < 1$$

$$\text{cn}(x, k) = 1 - \frac{1}{2}x^2 + \frac{1}{24}(1 + 4k^2)x^4 + \ldots$$

$$\cos x = 1 - \frac{1}{2}x^2 + \frac{1}{24}x^4 - \frac{1}{720}x^6 + \ldots \text{ for } -\infty < x < \infty$$

$$\cos^{-1} x = \frac{1}{2}\pi - x - \frac{1}{6}x^3 - \frac{3}{40}x^5 - \frac{5}{112}x^7 - \ldots \text{ for } -1 < x < 1$$

$$\cosh x = 1 + \frac{1}{2}x^2 + \frac{1}{24}x^4 + \frac{1}{720}x^6 + \frac{1}{40{,}320}x^8 + \ldots$$

$$\cot^{-1} x = \frac{1}{2}\pi - x + \frac{1}{3}x^3 - \frac{1}{5}x^5 + \frac{1}{7}x^7 - \frac{1}{9}x^9 + \ldots$$

$$\text{dn}(x, k) = 1 - \frac{1}{2}k^2 x^2 + \frac{1}{24}k^2(4 + k^2)x^4 + \ldots$$

$$\text{erf}(x) = \frac{1}{\sqrt{\pi}}\left(2x - \frac{2}{3}x^3 + \frac{1}{5}x^5 - \frac{1}{21}x^7 + \ldots\right)$$

$$e^x = 1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \ldots \text{ for } -\infty < x < \infty$$

$${}_2F_1(\alpha, \beta; \gamma; x) = 1 + \frac{\alpha\beta}{1!\,\gamma}x + \frac{\alpha(\alpha+1)\beta(\beta+1)}{2!\,\gamma(\gamma+1)}x^2 + \ldots$$

$$\ln(1 + x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \frac{1}{4}x^4 + \ldots \text{ for } -1 < x < 1$$

$$\ln\left(\frac{1+x}{1-x}\right) = 2x + \frac{2}{3}x^3 + \frac{2}{5}x^5 + \frac{2}{7}x^7 + \ldots \text{ for } -1 < x < 1$$

$$\sec x = 1 + \frac{1}{2}x^2 + \frac{5}{24}x^4 + \frac{61}{720}x^6 + \frac{277}{8064}x^8 + \ldots$$

$$\text{sech}\, x = 1 - \frac{1}{2}x^2 + \frac{5}{24}x^4 - \frac{61}{720}x^6 + \frac{277}{8064}x^8 + \ldots$$

$$\sin x = x - \frac{1}{6}x^3 + \frac{1}{120}x^5 - \frac{1}{5040}x^7 + \ldots \text{ for } -\infty < x < \infty$$

$$\sin^{-1} x = x + \frac{1}{6}x^3 + \frac{3}{40}x^5 + \frac{5}{112}x^7 + \frac{35}{1152}x^9 + \ldots$$

$$\sinh x = x + \frac{1}{6}x^3 + \frac{1}{120}x^5 + \frac{1}{5040}x^7 + \frac{1}{362880}x^9 + \ldots$$

$$\sinh^{-1} x = x - \frac{1}{6}x^3 + \frac{3}{40}x^5 - \frac{5}{112}x^7 + \frac{35}{1152}x^9 - \ldots$$

$$\text{sn}(x, k) = x - \frac{1}{6}(1 + k^2)x^3 + \frac{1}{120}(1 + 14k^2 + k^4)x^5 + \ldots$$

$$\tan x = x + \frac{1}{3}x^3 + \frac{2}{15}x^5 + \frac{17}{315}x^7 + \frac{62}{2835}x^9 + \ldots$$

$$\tan^{-1} x = x - \frac{1}{3}x^3 + \frac{1}{5}x^5 - \frac{1}{7}x^7 + \ldots \text{ for } -1 < x < 1$$

$$\tanh x = x - \frac{1}{3}x^3 + \frac{2}{15}x^5 - \frac{17}{315}x^7 + \frac{62}{2835}x^9 + \ldots$$

$$\tanh^{-1} x = x + \frac{1}{3}x^3 + \frac{1}{5}x^5 + \frac{1}{7}x^7 + \frac{1}{9}x^9 + \ldots.$$

APPENDIX 2

TABLE OF Z-TRANSORM

	$X(z)$	Region of existence
1	$\dfrac{z}{z-1}$	$All\ z$
$(-1)^n$	$\dfrac{z}{z+1}$	$\lvert z\rvert > 1$
$a^n u(n)$	$\dfrac{z}{z-a}$	$\lvert z\rvert > \lvert a\rvert$
$u(n-m)$	$z^{-m}.\dfrac{z}{z-1}$	$\lvert z\rvert > 1$
n	$\dfrac{z}{(z-1)^2}$	$\lvert z\rvert > 1$
n^2	$\dfrac{z^2+z}{(z-1)^3}$	$\lvert z\rvert > 1$
$n(n-1)$	$\dfrac{2z}{(z-1)^2}$	$\lvert z\rvert > 1$
n^k	$\dfrac{k!z}{(z-1)^{k+1}}$	$\lvert z\rvert > 1$
$u(n-1)$	$\dfrac{1}{z-1}$	$\lvert z\rvert > 1$
na^n	$\dfrac{az}{(z-a)^2}$	$\lvert z\rvert > \lvert a\rvert$
$u(n)\cos n\theta$	$\dfrac{z(z-\cos\theta)}{z^2-2z\cos\theta+1}$	$\lvert z\rvert > 1$
$u(n)\sin n\theta$	$\dfrac{z\sin\theta}{z^2-2z\cos\theta+1}$	$\lvert z\rvert > 1$
$r^n\cos n\theta$	$\dfrac{z(z-r\cos\theta)}{z^2-2zr\cos\theta+r^2}$	$\lvert z\rvert > \lvert r\rvert$

$r^n \sin n\theta$	$\dfrac{zr\sin\theta}{z^2 - 2zr\cos\theta + r^2}$	$\lvert z\rvert > \lvert r\rvert$
$a^n x(n)$	$X\left(\dfrac{z}{a}\right)$	$\lvert z\rvert > \lvert a\rvert$
$nx(n)$	$\dfrac{1}{z}\dfrac{dX(z)}{dz^{-1}}$	
$x(n)$ or $f(t)$	$X(z)$ or $F(z)$	
$\dfrac{1}{n}$	$\log\left(\dfrac{z}{z-1}\right)$	$\lvert z\rvert > 1$
$\delta(n)$	1	
$\delta(n-k)$	$\dfrac{1}{z^k}$	
$a^n u(n)$	$\dfrac{z}{z-a}$	
$a^n \cos n\theta \,.\, u(n)$	$\dfrac{z(z-a\cos\theta)}{z^2 - 2az\cos\theta + a^2}$	
$a^n \sin n\theta \,.\, u(n)$	$\dfrac{az\sin\theta}{z^2 - 2az\cos\theta + a^2}$	
$na^n \,.\, u(n)$	$\dfrac{az}{(z-a)^2}$	
$(n+1)a^n \,.\, u(n)$	$\dfrac{z^2}{(z-a)^2}$	
$n(n-1)a^n \,.\, u(n)$	$\dfrac{2a^2 z}{(z-a)^3}$	
$u(n)$	$\dfrac{z}{z-1}$	$\lvert z\rvert > 1$
$Z(t)$	$\dfrac{Tz}{(z-1)^2}$	

$Z\left(t^2\right)$	$\dfrac{T^2 z(z+1)}{(z-1)^3}$	
$Z\left(t^3\right)$	$\dfrac{T^3 z\left(1+4z-z^2\right)}{(z-1)^4}$	
$Z\left(t^k\right)$	$-Tz\dfrac{d}{dz}\left[Z\left(t^{k-1}\right)\right]$	
$a^n \cos\dfrac{n\pi}{2}$	$\dfrac{z^2}{z^2+a^2}$	
$a^n \sin\dfrac{n\pi}{2}$	$\dfrac{az}{z^2+a^2}$	
$a^n f(t)$	$F\left(\dfrac{z}{a}\right)$	
$nf(nT)=nf(t)$	$-z\dfrac{d}{dz}[F(z)]$	
k	$\dfrac{kz}{z-1}$	$\lvert z\rvert > 1$
e^{-at}	$\dfrac{z}{z-e^{-aT}}$	$\lvert z\rvert > \lvert e^{-aT}\rvert$
e^{at}	$\dfrac{z}{z-e^{aT}}$	$\lvert z\rvert > \lvert e^{aT}\rvert$
$\cos\omega t$	$\dfrac{z(z-\cos\varpi T)}{z^2-2z\cos\omega T+1}$	$\lvert z\rvert > 1$
$\sin\omega t$	$\dfrac{z\sin\omega T}{z^2-2z\cos\omega T+1}$	$\lvert z\rvert > 1$